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Botany

Published by Field Museum of Natural History

New Series, No. 4

FLORA COSTARICENSIS

WILLIAM BURGER, Editor

FAMILY #15, GRAMINEAE

RICHARD W. POHL

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Publication 1313

Families of seed plants known or expected to occur in Costa Rica and adjacent areas, listed alphabetically and numbered according to the sequence of Engler's *Syllabus der Pflanzenfamilien*, edition 11, reworked by L. Diels (1936).

200	Acanthaceae	102	Erythroxylaceae	82	Papaveraceae
186	Actinidiaceae	113	Euphorbiaceae	150	Passifloraceae
67	Alzooaceae	96	Fabaceae	195	Pedaliaceae
11	Alismaceae		see Leguminosae	66	Phytolaccaceae
64	Amaranthaceae	50	Fagaceae	5	Pinaceae
50	Amaryllidaceae	148	Flacourtiaceae	41	Piperaceae
117	Anacardiaceae	82	Fumariaceae	171	Pyrolaceae
77	Anonaceae		see Papaveraceae	201	Plantaginaceae
184	Apocynaceae	45	Garryaceae	176	Plumbaginaceae
119	Aquifoliaceae	183	Gentianaceae	3	Podocarpaceae
19	Araceae	99	Geraniaceae	54	Podocetemonaceae
166	Araliaceae	198	Gesneriaceae	187	Polemoniaceae
4	Araucariaceae	7	Gnetaceae	111	Polygalaceae
59	Aristolochiaceae	15	Gramineae	82	Polygonaceae
185	Asclepiadaceae	142	Guttiferae	26	Pontederiaceae
61	Balanophoraceae	29	Haemodoraceae	68	Portulacaceae
127	Balsaminaceae	165	Halorrhagaceae	9	Potamogetonaceae
69	Basellaceae	93	Hamamelidaceae	175	Primulaceae
48	Batiaceae	81	Hernandiaceae	55	Proteaceae
153	Begoniaceae	124	Hippocastanaceae	158	Punicaceae
74	Berberidaceae	121	Hippocrateaceae	140	Quilnaceae
49	Betulaceae	101	Humiriaceae	60	Rafflesiaceae
194	Bignoniaceae		see Linaceae	73	Ranunculaceae
145	Bixaceae	13	Hydrocharitaceae	85	Resedaceae
133	Bombacaceae	188	Hydrophyllaceae	128	Rhamnaceae
189	Boraginaceae	142	Hypericaceae	160	Rhizophoraceae
24	Bromeliaceae		see Guttiferae	94	Rosaceae
91	Brunelliaceae	123	Icacinaceae	202	Rubiaceae
38	Burmanniaceae	33	Iridaceae	104	Rutaceae
106	Burseraceae	47	Juglandaceae	126	Sabiaceae
12	Butomaceae	27	Juncaceae	44	Salicaceae
115	Buxaceae	97	Krameriaceae	125	Sapindaceae
154	Cactaceae	191	Labiatae	177	Sapotaceae
96	Caesalpiniaceae	43	Lacistemaceae	90	Saxifragaceae
	see Leguminosae	80	Lauraceae	193	Scrophulariaceae
114	Callitrichaceae	159	Lecythidaceae	105	Simarubaceae
207	Campanulaceae	96	Leguminosae	192	Solanaceae
96	Cannaceae	20	Lemnaceae	122	Staphyleaceae
83	Capparidaceae	199	Lentibulariaceae	134	Sterculiaceae
203	Caprifoliaceae	23	Liliaceae	180	Styracaceae
151	Caricaceae	101	Linaceae	179	Symplocaceae
198	Caryocaraceae	152	Loasaceae	2	Taxaceae
70	Caryophyllaceae	182	Loganiaceae	141	Theaceae
40	Casuarinaceae	58	Loranthaceae	173	Theophrastaceae
120	Celastraceae	157	Lythraceae	155	Thymelaeaceae
72	Ceratophyllaceae	76	Magnoliaceae	131	Tiliaceae
63	Chenopodiaceae	108	Malpighiaceae	85	Tovariaceae
42	Chloranthaceae	132	Malvaceae	109	Trigonaceae
144	Cistaceae	37	Marantaceae	14	Triuridaceae
169	Clethraceae	139	Marcgraviaceae	100	Tropaeolaceae
146	Cochlospermaceae	196	Martyniaceae	149	Turneraceae
161	Combretaceae	21	Mayaceae	8	Typhaceae
25	Commelinaceae	163	Melastomataceae	51	Ulmaceae
208	Compositae	107	Meliaceae	167	Umbelliferae
95	Connaraceae	75	Menispermaceae	53	Urticaceae
186	Convulvulaceae	96	Mimosaceae	204	Valerianaceae
116	Coriariaceae		see Leguminosae	31	Velloziaceae
168	Cornaceae	79	Monimiaceae	190	Verbenaceae
89	Crassulaceae	170	Monotropaceae	147	Violaceae
84	Cruciferae	52	Moraceae	129	Vitaceae
206	Cucurbitaceae	87	Moringaceae	110	Vochysiaceae
92	Cunoniaceae	24	Musaceae	22	Xyridaceae
6	Cupressaceae	46	Myricaceae	35	Zingiberaceae
1	Cycadaceae	78	Myristicaceae	103	Zygophyllaceae
18	Cyclanthaceae	174	Myrsinaceae		
16	Cyperaceae	162	Myrtaceae		
118	Cyrtillaceae	10	Najadaceae		
112	Dichapetalaceae	65	Nyctaginaceae		
135	Dilleniaceae	71	Nymphaeaceae		
82	Dioscoreaceae	187	Ochnaceae		
205	Dipsacaceae	56	Olaceae		
88	Droseraceae	181	Oleaceae		
178	Ebenaceae	164	Onagraceae		
156	Elaeagnaceae	57	Opiliaceae		
130	Elaocarpaceae	39	Orchidaceae		
143	Elatinaceae	197	Orobanchaceae		
172	Ericaceae	98	Oxalidaceae		
23	Eriocaulaceae	17	Palmae		

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My study of Costa Rican grasses began while I was an instructor in a course on tropical grasses given by the Organization for Tropical Studies during the summer of 1966. The organization has since that time furnished aid in many ways, including logistic support and the use of its bases in Costa Rica. My special thanks go to Sr. Jorge Campabadal, Resident Director of the O.T.S. in San José, for the many ways in which he made my field work easier and more productive. Dr. Rafael Rodríguez C. of the Department of Biology of the University of Costa Rica furnished laboratory space and equipment for the 1968-1969 year, and has given generously of his time and counsel during the entire time of the field work. The Museo Nacional de Costa Rica and Sr. Luis Diego Gómez P. furnished facilities, the use of the herbarium, and the use of a field vehicle. The family of Mr. Werner Hagnauer of Finca la Pacifica at Cañas furnished not only food, shelter, and a kindly atmosphere, but much sagacious counsel on field travel in Guanacaste. Dr. Gerrit Davidse, currently of the Missouri Botanical Garden in St. Louis, was my field companion in Costa Rica from June, 1968 to May, 1969. Much of the success of the field program is due to his indefatigable efforts. He is also responsible for many of the hundreds of chromosome counts that we obtained from Central American grasses, which are reported in the text.

Field Museum has furnished access to its herbarium and library, and allowed the use of its field vehicles in Costa Rica. My special thanks are due to Louis Williams and William Burger of the Museum. During my many visits to the U.S. National Herbarium, Dr. Thomas Soderstrom and Dr. Cleofé Calderón furnished facilities, access to literature, and aid in identifications.

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ILLUSTRATIONS

The majority of the illustrations of grasses in this publication are the work of Judy Appenzeller LaMotte (JEA). Most of the remainder are taken from the illustrations of various publications of Agnes Chase and A. S. Hitchcock, the originals of which are now in the Hunt Center for Botanical Documentation and are used with the kind permission of that institution. Scale lines for spikelets are 1 mm. long; for larger structures, 1 cm. long.

ABBREVIATIONS

BREM	Übersee-Museum, Bremen, Federal Republic of Germany
CATIE	Centro Agronomico Tropical de Investigación y Enseñanza, Turrialba
CIA	Carretera Interamericana (Interamerican Highway)
CR	Herbario Nacional, Museo Nacional de Costa Rica, San José
F	Field Museum of Natural History
IICA	Instituto Interamericana de Ciencias Agrícolas, Turrialba
ISC	Iowa State University Herbarium, Ames, Iowa
JEA	Judy Appenzeller LaMotte, artist
US	United States National Herbarium, Smithsonian Institution, Washington, D.C.

GRAMINEAE (POACEAE). GRASS FAMILY

REFERENCES: N. L. Bor, The grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae). XVIII + 767 pp. Pergamon Press. London. 1960. A. Burkart (ed.) & collaborators, Flora Ilustrada de Entre Rios (Argentina), Parte II: Gramineas. V + 551 pp. Colección Científica del I.N.T.A., Tomo VI, II. Buenos Aires. 1969. E. G. Camus, Les Bambusees. Texte, 215 pp. Lechevalier. Paris. 1913. + Atlas of 101 plates. Not dated. W. D. Clayton, Flora of Tropical East Africa, Gramineae, Part 1:1-176. Government Bookshops. London. 1970. E. Fournier, Mexicanas Plantas, Pars Secunda. Gramineae. 160 pp. Typographeo Reipublicae. Paris. 1881. J. S. Gamble, The Bambuseae of British India, Ann. Roy. Bot. Gard. (Calcutta). 1896. Reprint by Micro Methods Ltd. & Johnson Reprint Corp. 1966. A. S. Hitchcock, The grasses of Central America, Contr. U.S. Natl. Herb. 23(9):XVI + 557-762. U.S. Govt. Printing Office. Washington, D.C. 1930. A. S. Hitchcock, Manual of the grasses of the West Indies, Misc. Publ. 243, U.S. Dept. Agric. 439 pp. Govt. Printing Office. Washington, D.C. 1936. C. E. Hubbard, Flora of Tropical Africa. (A. W. Hill, ed.) 10(1): 192 pp. L. Reeve. Ashford. 1937. H. Jacques-Félix, Les Gramineés (Poaceae) D' Afrique Tropicale I. Généralités, Classification Description des Genres. XI + 345 pp. Ins. Recherches Agron. Trop. Paris. 1962. A. S. Maroto, Los Forrajes de Costa Rica. 606 pp. Universidad de Costa Rica. San José. 1955. F. A. McClure, Genera of bamboos native to the New World (Gramineae: Bambusoideae, Smithsonian Contr. Bot. 9:XI + 148. Smithsonian Inst. Press. Washington, D.C. 1973. New York Bot. Gard. ed. 1912-1939. North American Flora 17:77-638, Family Poaceae. Parts 1, 2, 3 by G. V. Nash, 1912-15 pp. 77-288; Parts 4, 5, 6, 7 by A. S. Hitchcock, 1935-37, pp. 289-354; Part 8, by A. S. Hitchcock, J. R. Swallen, & Agnes Chase, 1939, pp. 543-638. H. Pittier, Ensayo sobre Plantas Usuales de Costa Rica, ed. 2. Revised by R. Rodriguez C. 264 pp. + 50 plates. Editorial Universitaria. San José. 1957. B. Rosengurtt, B. R. Arrillaga de Maffei, & P. Izaguirre de Artucio. Gramineas Uruguayas.

VII + 489 pp. Universidad de la Republica. Montevideo. 1970. O. Stapf, *Flora of Tropical Africa*. (D. Prain, ed.) IX. Gramineae (Maydeae-Paniceae). VI + 1,132 pp. L. Reeve. London 1917-1934. G. L. Stebbins, Jr., & B. Crampton, A suggested revision of the grass genera of North America, *Recent Advances in Botany*. pp. 133-145. 1961. J. R. Swallen, The grasses of the Yucatan Peninsula, Appendix to *Contr. Amer. Archaeol.*, No. 12. Carnegie Inst. Wash. Publ. 436:323-355. 1934. J. R. Swallen, Botany of the Maya Area: Miscellaneous Papers IX: The grasses of British Honduras and the Peten, Guatemala, Carnegie Inst. Wash. Publ. 461:141-189. 1936. J. R. Swallen, *Flora of Panama: Gramineae*, *Ann. Missouri Bot. Gard.* 30:104-280. 1943. J. R. Swallen, *Flora of Guatemala*, Part II: Grasses of Guatemala (Bamboos by F. A. McClure), *Fieldiana, Bot.* 24, Pt. II: IX + 390 pp. 1955.

Mostly herbaceous plants, occasionally shrubby or treelike, as in the bamboos. Root systems fibrous, mostly lacking in characters of systematic importance, in large part of adventitious origin from the basal nodes, the primary root soon dying. Stems conspicuously jointed, mostly with hollow internodes and solid nodes; aerial stems (culms) mostly terminating in inflorescences; plants also producing young vegetative stems (innovations) from the base. Plants variously clump-forming (caespitose) or with stolons or rhizomes. Branches ordinarily 1 per node, the base subtended by a highly modified bracteal leaf, the prophyllum, attached to the base of the branch and tending to hold together the main stem and the branch. Foliage leaves alternate, spaced 180 deg. apart on the stem. Each leaf consists of three major parts, these being the sheath that surrounds the internode and which usually has overlapping edges; the ligule, a small membranaceous or hairy rim or projection at the juncture of the sheath and the leaf blade; and the usually flat, linear, parallel-veined leaf blade. In addition to these structures, the following are sometimes seen. The flange, or dewlap, is a triangular outpouched area between the summit of the sheath and the blade proper. It permits upward and downward motion of the blade. The collar is the line of union between the lower surface of the blade and the sheath. Auricles are rounded or pointed projections of the base of the blade or the summit of the sheath. In bamboos and their relatives and a few other grasses, a narrow stalk is intercalated between the base of the blade proper and the summit of the sheath. This is the pseudopetiole, morphologically a portion of the leaf blade and not a true petiole.

Grass inflorescences are extremely variable, and difficult to confine to a simple system of nomenclature. Since grasses do not have naked individual flowers, the terminology ordinarily used for inflorescences does not well fit their flowering structures. While authors have ordinarily used standard inflorescence names in describing grasses, it should be borne in mind that such usage always implies that the flowering unit is a spikelet, not an individual flower. I have used the terms panicle, spike, and raceme in the usual sense, but have added a new term, RAME, to indicate an unbranched axis that bears both sessile and pedicellate spikelets. This term is convenient to indicate the flowering axes of the Tribe Andropogoneae, where one of each pair of spikelets may be sessile and the other pedicellate. Inflorescences are often terminal on the culms of

grasses, but in many cases axillary ones are also produced. In one genus (*Pariana*) naked inflorescences arise from the soil level, and in a few grasses (*Chloris chloridea*, the genus *Amphicarpum*) entirely subterranean inflorescences occur.

The spikelet is the basic unit of the grass inflorescence. It is a small axis (rachilla) bearing alternate overlapping bracts distichously. It is never secondarily branched, thereby differing from other inflorescence structures. Usually spikelets are borne on slender stalks, the pedicels. The lowermost two (rarely one) bracts of the spikelet (glumes) are sterile.

Successive nodes of the rachilla above the glumes bear flowering units called florets. The floret consists of an outer bract, the lemma, attached to the rachilla itself, an inner bract, the palea, attached to the flower axis, and the included flower. The lemma and palea together are sometimes called the anthoecium (antherium). The lemma may bear a projecting midrib, the awn. Rarely lateral nerves (vascular bundles) may also be extended into awns, as in *Aristida*. The inner floral bract, the palea, is the homologue of the prophyllum found on vegetative parts of the plant. In spikelets with several florets, disarticulation often takes place at the apex of each rachilla internode, so that the disseminules are individual florets. In the Subfamily Panicoideae, in general, and in various other genera, the entire spikelet is shed from the plant as a unit.

Grass flowers are very small, and lack a conspicuous perianth. The vestiges of the perianth are small fleshy or scale-like bodies called lodicules. Two lodicules are present in all the grass subfamilies with the exception of the Bambusoideae. They are placed at the base of the ovary on the side toward the lemma, and serve, by their rapid swelling, to force the lemma outward and permit the exposure of the anthers and stigmas at anthesis. The shape, number, and vasculature, or lack of it, of the lodicules are characteristic of the various subfamilies of the Gramineae. In the Subfamily Pooideae, the lodicules are more or less pointed, flattened except near the swollen base, and non-vascular. In the Subfamilies Chloridoideae, Oryzoideae, and Panicoideae, the lodicules are thick, fleshy, truncate, and possess vascular traces. In the Bambusoideae, three lodicules are ordinarily present. They are flat, ovate, pointed, and have conspicuous forking vascular traces. A great majority of grasses have three stamens, with elongated flexuous filaments and large, versatile anthers. A few isolated species have one or two anthers, and the Bambusoideae ordinarily have six, or rarely other numbers. The gynoecium in most grasses, with the exception of the Bambusoideae, has two style branches bearing enlarged plumose stigmas. A third carpel is represented only by a vascular bundle in the ovary wall. In the Bambusoideae, most species have a single style bearing three rather small stigmas. With rare exceptions, grasses have some or all of the flowers perfect. A few monoecious or dioecious grasses occur in widely disparate groups of grasses.

The fruit in grasses is generally a caryopsis, a single-seeded dry indehiscent grain with the pericarp and seed united. In a few genera, notably *Sporobolus*, the pericarp gelatinizes and separates from the seed. In the bamboos, various types of specialized grass fruits occur.

While true grass spikelets never rebranch, some bamboos and their herbaceous relatives have complex bracted structures which branch secondarily into the true spikelets. Such structures are designated as pseudospikelets.

The duration of the life of grasses is usually designated as annual or perennial. While this distinction is fairly usable in the temperate zone,

it does not work well in the tropics, where frost or drought does not often occur to terminate the life of the individual. In instances where it seems impossible to determine the life span of plants of a species, I have indicated this by the statement "duration indefinite." In the tropics, stoloniferous grasses frequently fall into this category.

Measurements given in this work are derived primarily from Central American specimens. It is possible that material from other areas might yield larger or smaller values. Plane shapes of structures are designated according to the International Association for Plant Taxonomy chart (Taxon 11:145-156. 1962). According to this system, a shape is designated by a general class, followed by a ratio indicating the length to width proportions, as for example: ovate 4:1; obovate 3-7:1.

The abbreviations CIA, for Carretera Interamericana (the Pan American Highway), and P.&D., for collections of Pohl & Davidse, are often used in the discussions under the species.

Chromosome numbers cited in the text are mostly derived from counts made by the author and Dr. Gerrit Davidse and published in the following series of papers: R. W. Pohl & G. Davidse, Chromosome numbers of Costa Rican grasses, *Brittonia* 23:293-324. 1971. G. Davidse & R. W. Pohl, Chromosome numbers and notes on some Central American grasses, *Canad. J. Bot.* 50:273-283. 1972; Chromosome numbers, meiotic behavior, and notes on some grasses from Central America and the West Indies, *Canad. J. Bot.* 50:1441-1452. 1972; Chromosome numbers, meiotic behavior, and notes on tropical American grasses (Gramineae), *Canad. J. Bot.* 52:317-328. 1974.

CLASSIFICATION OF THE GRASS FAMILY

For many years, the standard classification of the Gramineae used in most works of American origin was that of A. S. Hitchcock. This system featured the use of two large subfamilies, the Festucoideae and Panicoideae, and a rather limited number of inclusive tribes. Studies in grass morphology, anatomy, cytology, ecology, and physiology indicate that this system did not make sufficient allowance for the widespread and frequent occurrence of convergent evolution in external form. A number of newer systems of classification, utilizing a much wider range of data in the formulation of the major categories, have been proposed in recent years. The system used for this work is based largely on the one proposed for the American temperate zone elements of the family by G. L. Stebbins and Beecher Crampton. I have modified this system in detail, but the general outline follows the work of the above authors. While the system has much higher phylogenetic and predictive value than older arrangements, it does not lend itself to use for routine identification. I have therefore constructed artificial keys to assist in identification, and the arrangement in the text is strictly alphabetical.

The following brief summary will serve to indicate the principal characteristics of each of the six subfamilies recognized in this treatment, and indicate the Costa Rican genera belonging to each one.

SUBFAMILY I. BAMBUSOIDEAE

This subfamily includes the bamboos and a number of herbaceous grasses, mostly found in moist forests of the tropics, which resemble the bamboos in their leaf epidermal and cross-sectional anatomy, the number and nature of lodicules, the number of stamens and stigmas. The bamboos are readily recognized by their woody stems, and all of these grasses possess at least short pseudopetioles. The following genera occur in Costa Rica:

Woody bamboos.—*Arthrostylidium*, *Aulonemia*, *Bambusa*,

Chusquea, *Elytrostachys*, *Merostachys*, *Rhipidocladum*, *Swallenochloa*. A number of other genera are cultivated, including species of *Phyllostachys*, *Yushania*, and *Bambusa*.

Herbaceous bamboos: *Cryptochloa*, *Lithachne*, *Olyra*, *Pariana*, *Raddia*, *Pharus*, *Streptochaeta*, *Streptogyna*.

The treatment of the bamboos in this work is necessarily tentative. Many of the species bloom only after long intervals of years, and some have never been observed to bloom in our area. Much more field and herbarium work will have to be done before a definitive treatment of the Central American bamboos can be produced.

SUBFAMILY II. ORYZOIDEAE

This is a relatively small subfamily, allied to the bambusoids by anatomical characteristics and chromosome numbers. Their spikelets have very reduced or vestigial glumes, usually appearing as a minute cupule at the apex of the pedicel. There is only one fertile floret. All are plants of wet ground or water. The following genera occur in Costa Rica: *Leersia*, *Luziola*, *Oryza*.

SUBFAMILY III. POOIDEAE (FESTUCOIDEAE)

This is a large subfamily, containing many of the grasses of the temperate and cold regions of the world. In Central America, relatively few of them occur, and these mostly at high elevations. They are characterized by rather simple leaf anatomy, reduced embryo structure, and the possession of large chromosomes in multiples of seven. The following genera occur in Costa Rica, some of them as introductions in upland pastures: *Aciachne*, *Agropyron*, *Agrostis*, *Aira*, *Anthoxanthum*, *Avena*, *Briza*, *Brachypodium*, *Bromus*, *Calamagrostis*, *Cinna*, *Cynosurus*, *Dactylis*, *Deschampsia*, *Festuca*, *Glyceria*, *Hierochloë*, *Holcus*, *Lolium*, *Lorenochloa*, *Nassella*, *Phalaris*, *Poa*, *Polypogon*, *Secale*, *Stipa*, *Triniochloa*, *Trisetum*, *Vulpia*.

SUBFAMILY IV. ARUNDINOIDEAE

This subfamily contains numerous large, reedlike grasses, often with plumelike, fuzzy panicles. Other genera included here are placed largely on anatomical grounds. Costa Rican representatives are: *Aristida*, *Arundo*, *Cortaderia*, *Danthonia*, *Gynerium*, *Orthoclada*, *Phragmites*, *Zeugites*.

SUBFAMILY V. CHLORIDOIDEAE (ERAGROSTOIDEAE)

This is an abundant subfamily of warm climates. They are fundamentally characterized by microscopic characters, including the elabo-

rately structured leaf cross-section, featuring a number of quasi-independent units, the cells of each radiating around a single vascular bundle. In many, the lemmas have three strong vascular bundles, in contrast to the five or more faint bundles in lemmas of most pooid grasses. The following genera occur in Costa Rica, mostly at low or middle elevations: *Aegopogon*, *Bouteloua*, *Chloris*, *Cynodon*, *Dactyloctenium*, *Eleusine*, *Eragrostis*, *Gouinia*, *Gymnopogon*, *Jouvea*, *Leptochloa*, *Muhlenbergia*, *Pentarraphis*, *Pereilema*, *Spartina*, *Sporobolus*, *Triplasis*, *Uniola*, *Zoysia*.

SUBFAMILY VI. PANICOIDEAE

This is by far the largest subfamily of warm climate grasses, forming a significant portion of the grass cover in tropical regions. Spikelets, with rare exceptions, are dorsally compressed, have a single perfect flower, and disarticulate below the glumes. Genera occurring in Costa Rica are the following: *Acroceras*, *Andropogon*, *Antheophora*, *Arthraxon*, *Arundinella*, *Axonopus*, *Bothriochloa*, *Brachiaria*, *Cenchrus*, *Chaetium*, *Coelorachis*, *Coix*, *Cymbopogon*, *Diectomis*, *Digitaria*, *Echinochloa*, *Echinolaena*, *Eremochloa*, *Eriochloa*, *Eriochrysis*, *Euclasta*, *Hackelochloa*, *Homolepis*, *Hymenachne*, *Hyparrhenia*, *Hypogynium*, *Ichnanthus*, *Imperata*, *Isachne*, *Ischaemum*, *Ixophorus*, *Lasiacis*, *Leptocoryphium*, *Melinis*, *Mesosetum*, *Oplismenus*, *Panicum*, *Paratheria*, *Paspalidium*, *Paspalum*, *Pennisetum*, *Polytrias*, *Pseudechinolaena*, *Rhynchelytrum*, *Rottboellia*, *Saccharum*, *Sacciolepis*, *Schizachyrium*, *Setaria*, *Sorghastrum*, *Sorghum*, *Stenotaphrum*, *Thrasya*, *Trachypogon*, *Tripsacum*, *Urochloa*, *Vetiveria*, *Zea*.

MASTER KEY

- 1a. Culms at least 2 m. tall, woody and perennial; foliage leaves usually borne on secondary branches; rarely blooming KEY I
- 1b. Culms herbaceous, usually less than 2 m. tall; foliage leaves on main culms as well as branches; blooming annually 2
 - 2a. All or some spikelets borne partially or completely concealed, in spiny burs, or bony rachis joints, or bead-like or horn-like structures, or detachable fascicles of hard bracts, or completely hidden in leaf sheaths with only the stamens and stigmas visible KEY II
 - 2b. Spikelets borne in the open, in panicles, racemes, rames, or spike-like inflorescences 3
- 3a. Leaf blades separated from sheaths by slender pseudopetiole, 5 mm.-several cm. long KEY III
- 3b. Leaf blades attached directly to sheaths, or with short pseudopetioles not more than 1-3 mm. long 4

- 4a. Spikelets disarticulating above the glumes which remain attached to pedicels as visible bracts KEY IV
- 4b. Spikelets disarticulating completely from the pedicels, no glumes remaining on the plant, or at the most a minute nerveless cupule 5
- 5a. Spikelets all falling as single units, without attached accessory structures KEY V
- 5b. Spikelets, or some of them, falling in clusters or with attached rachis, pedicels, or sterile, bristle-like branches KEY VI

KEY I

GIANT GRASSES; CULMS 2-30 M. TALL, OFTEN WOODY OR SOLID

- 1a. Culm internodes solid, without central lumen 2
- 1b. Culm internodes with small or large central lumen 4
 - 2a. Leaf blades 1-several m. long, borne on main culm; culms pithy, not extremely woody 3
 - 2b. Leaf blades usually less than 20 cm. long, mostly borne on small lateral branches, main culms naked or bearing bladeless sheaths *Chusquea*
- 3a. Leaf blades distributed along culms; spikelets single-flowered, disarticulating below glumes; cultivated crop (sugar cane; caña de azucar); pith sweet *Saccharum officinarum*
- 3b. Leaf blades borne in a large, fan-shaped cluster at the apex of culm; spikelets 2-flowered, disarticulating above the glumes; wild plants, usually growing on river banks; pith not sweet *Gynerium sagittatum*
 - 4a. Leaf blades 1-2 m. long, cordate-clasping at base, borne on main culm, often yellow-striped; culms thin-walled; plants cultivated for ornament, rarely escaping to the wild *Arundo donax*
 - 4b. Leaf blades usually 20 cm. long or shorter, not cordate-clasping, mostly with short pseudopetioles; wild or cultivated plants 5
- 5a. Culms with thorny branches *Bambusa*
- 5b. Culms lacking thorny branches 6
 - 6a. Culms barely woody, internodes slender (1 cm. or less), green, and soft (can be crushed with the fingers) 7
 - 6b. Culms definitely woody, of various diameters 9
- 7a. Culms with glistening, viscid band at nodes; plants rarely blooming *Aulonemia*
- 7b. Culms not viscid; plants annual bloomers 8
 - 8a. Spikelets alike, black and shiny when mature, placed at an angle to pedicel; disarticulation below glumes; leaf blades sessile, without pseudopetioles *Lasiacis*
 - 8b. Spikelets unisexual, of 2 kinds, not black, aligned with pedicel; disarticulation above glumes; leaf blades with short pseudopetiole *Olyra*
- 9a. Bamboos of various habits, in forested or savanna habitats below 3,000 m. elevation; lumen of internodes usually large and with definite boundary membrane; branches 2-many per node 10
- 9b. Small, shrubby bamboos of páramos above 3,000 m. elevation; central lumen of

- culm internodes small, lacking definite boundary membrane; branches stiff and erect, usually 3-5 per node *Swallenochloa*
- 10a. Branches at midculm nodes numerous, arising from edges of flat, triangular plate-like meristem that is closely appressed to main culm 11
- 10b. Branches at midculm nodes not arising from flat plate, of varying number . 12
- 11a. Midculm sheaths with a narrow reflexed blade that is constricted at its base and much narrower than sheath apex *Merostachys*
- 11b. Midculm sheaths with an erect blade that is as wide as the sheath apex and not constricted at the base *Rhipidocladum*
- 12a. Primary midculm branches solitary, soon branched near the base; auricular bristles very prominent, up to 8 cm. long on the main culm sheaths
Elytrostachys
- 12b. Primary midculm branches 2-several per node; auricular bristles short . 13
- 13a. Branches 3-many per node, arising above the node at the apex of a prominent bulge that continues down to the node; internodes cylindrical in cross-section; wild plants
Arthrostylidium
- 13b. Primary branches usually 2 per node; internodes D-shaped in cross-section; cultivated bamboos, used for hedges, banana props, etc. *Phyllostachys*

KEY II

GRASSES WITH VARIOUSLY CONCEALED OR HIGHLY MODIFIED SPIKELETS

- 1a. Low, stoloniferous grass of mountain pastures; spikelets concealed within sheaths, only stigmas and stamens protruding *Pennisetum clandestinum*
- 1b. Grasses of various statures; spikelets not all concealed in leaf sheaths 2
- 2a. Inflorescence a spike of densely spiny, readily detached burs, each concealing 1-several spikelets *Cenchrus*
- 2b. Inflorescence not bearing spiny burs 3
- 3a. Inflorescence an unbranched spike bearing fascicles of coriaceous flat bracts which conceal spikelets, fascicles readily detached from zigzag rachis
Antheophora hermaphrodita
- 3b. Inflorescence rachis without detachable fascicles 4
- 4a. Low stoloniferous or rhizomatous widely spreading plants 5
- 4b. Plants not stoloniferous or rhizomatous; culms erect 6
- 5a. Sheaths strongly flattened and keeled; plants stoloniferous on moist soil; spikelets sunken into one side of flattened, corky, club-shaped erect rachis; spikelets perfect-flowered *Stenotaphrum secundatum*
- 5b. Sheaths not keeled; plants stoloniferous or rhizomatous, forming mats or mounds on coastal sand dunes or mud flats; plants dioecious; pistillate plants bearing rigid, pointed horns containing caryopses, in clusters at tips of the culms *Jouvea*
- 6a. Pistillate spikelets borne in single spheroidal beads on tips of axillary peduncles; staminate inflorescence a short cluster of spikelets protruding from opening of bead *Coix lacryma-jobi*
- 6b. Pistillate spikelets borne in exposed spikes or on axillary cobs concealed in leaf sheaths, never in beadlike structures 7
- 7a. Staminate spikelets borne on terminal panicle; pistillate spikelets borne on a thick

7b. Plants large or small, of various habitats; inflorescences with many spikelets, supported above foliage on peduncle	9
8a. Leaf blades sharp-pointed; first glume 3-5-nerved	<i>Aciachne pulvinata</i>
8b. Leaf blades with boat-shaped tips; first glume 1-nerved	<i>Muhlenbergia calciculata</i>
9a. Floret hard, smooth, usually awned	10
9b. Floret soft-textured, awned or awnless	16
10a. Floret awnless, laterally compressed, with 2 minute rudimentary florets attached below it and closely appressed to it, the three falling as a unit from glumes	<i>Phalaris</i>
10b. Floret awned, without rudimentary florets below, terete or nearly so ..	11
11a. Lemma bearing 3 awns, lateral 2 often smaller	<i>Aristida</i>
11b. Lemma bearing single awn	12
12a. Awn attached to back of lemma below tip	<i>Triniochloa stipoides</i>
12b. Awn attached at tip of lemma	13
13a. Palea exposed between edges of lemma	<i>Lorenzochloa</i>
13b. Palea concealed by overlapping margins of cylindrical lemma	14
14a. Floret plump, swollen near apex, the readily deciduous awn attached eccentrically	<i>Nassella</i>
14b. Floret slender-cylindrical, firmly attached awn attached at center of apex ..	15
15a. Awn glabrous, curved, not strongly twisted above base; in savannas at low elevations	<i>Aristida</i>
15b. Awn hairy below, straight but geniculate, strongly twisted above the base; upper elevations in mountains	<i>Stipa ichu</i>
16a. Fertile spikelets surrounded by cluster of bristles (abortive spikelets)	<i>Pereilema</i>
16b. Spikelets not surrounded by bristles	17
17a. Inflorescence a panicle	19
17b. Inflorescence of several-many 1-sided spikes or racemes	18
18a. Stoloniferous or rhizomatous plants; spikes digitate; lemmas awnless; common weed	<i>Cynodon</i>
18b. Tufted plants; spikes racemose; lemmas awned; rare, Boruca	<i>Gymnopogon fastigiatus</i>
19a. Both glumes longer than floret	20
19b. One or both glumes shorter than floret	21
20a. Rachilla prolonged behind palea of the floret as a thin, often hairy bristle; callus hairs often long and abundant, rarely short or scanty	58
20b. Rachilla not prolonged behind palea; callus hairs usually short or minute ..	59
21a. Awn arising from the back of lemma below tip	<i>Triniochloa stipoides</i>
21b. Awn absent or arising from tip of lemma	22
22a. Lemmas 1-nerved, awnless; ovary wall gelatinous and swollen when wet, the seed extruding from burst ovary	<i>Sporobolus</i>
22b. Lemmas 3-nerved, usually awned; ovary wall not becoming gelatinous, seed not extruding	<i>Muhlenbergia</i>
23a. Inflorescence a single balanced or 1-sided spike or raceme	24

- 23b. Inflorescence a panicle, or group of spikes or racemes borne on common peduncle 29
- 24a. Florets becoming entangled into single group by the elongated, stiff, spirally-coiled styles; stigmas 3 *Streptogyna americana*
- 24b. Florets not becoming entangled by styles; stigmas 2 25
- 25a. Spikelets on short, erect, hairy pedicels *Brachypodium mexicanum*
- 25b. Spikelets sessile 26
- 26a. Spikelets 2-flowered; keels of lemmas with row of short, stiff, spreading hairs; cultivated, upper elevations, rare *Secale cereale*
- 26b. Spikelets with more than 2 flowers; keels of lemmas without spreading hairs 27
- 27a. Spikelets placed edgewise to rachis, only exterior glume present; flowers perfect; upper elevation pastures *Lolium perenne*
- 27b. Spikelets placed flatwise to rachis; both glumes present 28
- 28a. Flowers staminate; wiry stoloniferous seashore plants *Jouvea*
- 28b. Flowers perfect; caespitose alpine plants; Cerro Chirripó Grande
Agropyron
- 29a. Tall, stout, reedlike grasses, culms usually 2-12 m. tall; panicles large, plumelike, spikelets silky because of abundant long hairs attached to lemmas or rachillas (glabrous in staminate *Gynerium*) 30
- 29b. Grasses of various statures, but usually less than 2 m. tall; inflorescences not silky-hairy 33
- 30a. Culms solid; leaves all in fan-shaped cluster near top of culms; spikelets with 2 florets, the staminate ones glabrous; panicles more than 1 m. long on larger plants *Gynerium sagittatum*
- 30b. Culms hollow; leaves basal or along culms; spikelets with more than 2 florets 31
- 31a. Lemmas hairy 32
- 31b. Lemmas glabrous; rachilla internodes long-hairy *Phragmites australis*
- 32a. Leaf blade bases very broad, conspicuously clasping; leaves spaced evenly along culms; blades often yellow-striped; flowers perfect; cultivated for ornament, or escaped *Arundo donax*
- 32b. Leaf blades narrow; leaves aggregated into basal cluster, the culms few-leaved; flowers functionally unisexual; usually páramo plants, one species rarely cultivated *Cortaderia*
- 33a. One or both glumes much shorter than spikelet 42
- 33b. Both glumes at least three-fourths as long as spikelet 34
- 34a. Lower 1 or 2 florets much longer than terminal floret and either staminate or sterile 35
- 34b. Lower florets about as long as upper florets, all perfect-flowered and similar to lowermost 37
- 35a. Spikelets 3-flowered, 1 or both of lower florets with awns and either staminate or sterile; plants with sweet odor of coumarin 36
- 35b. Spikelets 2-flowered, lower floret staminate, awnless; upper floret perfect, with conspicuous geniculate awn; plants not sweet-scented *Arundinella*
- 36a. Glumes very unequal; both of the 2 lower florets sterile
Anthoxanthum odoratum

- 36b. Glumes equal; at least 1 of lower florets staminate *Hierochloë*
- 37a. Spikelets 2 cm. or more long; glumes many-nerved; annual crop, persisting after cultivation in mountain fields *Avena sativa*
- 37b. Spikelets less than 2 cm. long; glumes 1-5-nerved 38
- 38a. Lemmas with 3 conspicuous nerves; spikelets nearly sessile, arranged in 2 rows along lower sides of the simple, elongated panicle branches; lemmas awnless or short-awned *Leptochloa*
- 38b. Lemmas with 5 or more nerves; spikelets variously arranged, mostly in open panicles, not along lower sides of simple panicle branches 39
- 39a. Florets 4-5; lemmas nearly awnless, bidentate at tip; rare introduction in high-elevation pastures *Danthonia decumbens*
- 39b. Florets 2-3; lemmas awned, the awn from the back or between teeth; plants of upper elevations 40
- 40a. Awn attached above middle of lemma *Trisetum*
- 40b. Awn attached near base of lemma 41
- 41a. Rachilla extending above base of upper floret as a minute hairy bristle; perennial *Deschampsia*
- 41b. Rachilla not extending beyond second floret; diminutive annual *Aira caryophyllea*
- 42a. Lemmas with 3 conspicuous nerves 43
- 42b. Lemmas with 5 or more inconspicuous nerves, or rarely only the midrib visible 50
- 43a. Spikelets with single fertile floret, a differently shaped rudimentary floret above it 44
- 43b. Spikelets with several-many similar florets 45
- 44a. Inflorescence of 1-several whorls of spikes; second floret with evident lemma 60
- 44b. Inflorescence a raceme of spikes; second floret much reduced, lemma scarcely wider than awn; rare, Boruca savannas *Gymnopogon fastigiatus*
- 45a. Spikelets sessile, pectinately arranged in short, thick, 1-sided spikes borne in 1 or 2 whorls 46
- 45b. Spikelets borne on pedicels, either in panicles, or racemosely along slender branches attached to central rachis 47
- 46a. Rachis of each spike extended beyond spikelets as naked tip; second glume bearing short, divergent awn *Dactyloctenium aegyptium*
- 46b. Rachis covered with spikelets to its tip; glumes not bearing awns *Eleusine indica*
- 47a. Palea long-hairy on its upper half; tip of lemma split, the short awn arising between 2 teeth; sandy Caribbean beaches *Triplasis*
- 47b. Palea not long-hairy; tip of lemma various; plants not confined to sandy beaches . 48
- 48a. Primary panicle branches elongated and simple, spikelets arranged in 2 rows along the lower side, on very short pedicels; lemmas awned or awnless. 49
- 48b. Primary panicle branches at least in part with secondary branches; spikelets not arranged in rows along lower sides; some of pedicels at least half as long as spikelets; lemmas awnless *Eragrostis*
- 49a. Glumes several-nerved; lemmas long-awned, spikelets 1-2 cm. long *Gouinia virgata*

- 49b. Glumes 1-nerved; lemmas short-awned or awnless; spikelets less than 5 mm. long
Leptochloa
- 50a. Spikelets all alike 51
- 50b. Spikelets paired, one of each pair sterile, containing only empty lemmas, its rachilla not disarticulating; the other fertile, its lemmas 1-nerved, rachilla disarticulating; panicle dense, spikelike; introduced in upper elevation pastures *Cynosurus cristatus*
- 51a. Leaf sheaths with united edges, at least for basal third of their length 52
- 51b. Leaf sheaths with overlapping edges 54
- 52a. Lemmas blunt-tipped, nerves running parallel to the midrib
Glyceria plicata
- 52b. Lemmas acute or awned, nerves converging toward the midrib 53
- 53a. Spikelets 2 cm. or more long, all on evident pedicels *Bromus*
- 53b. Spikelets less than 1 cm. long, subsessile, crowded in dense fascicles at tips of the few, rigid panicle branches *Dactylis glomerata*
- 54a. Plants tall, stout, extensively stoloniferous; on coastal sand dunes; spikelets strongly compressed and keeled *Uniola pittieri*
- 54b. Plants not stoloniferous; growing at middle and upper elevations; spikelets not strongly compressed and keeled 55
- 55a. Lemmas nearly circular in outline, spreading at right angles to rachilla, awnless and without evident nerves *Briza minor*
- 55b. Lemmas longer than wide, acute or awned at tip, placed at acute angles to rachilla 56
- 56a. Lemmas awned or acuminate; callus never bearing cottony hairs; leaf blades with acuminate tips 57
- 56b. Lemmas awnless, blunt or acute, pubescent on nerves or with a tuft of cottony hairs on callus; leaf blades with blunt, boat-shaped tips *Poa*
- 57a. Anther 1, usually not exerted from the cleistogamous florets; small caespitose annuals, leaf blades usually 1-2 mm. wide *Vulpia*
- 57b. Anthers 3, usually exerted during anthesis; leaf blades mostly 3 mm. or more wide; caespitose perennials, often tall *Festuca*
- 58a. Low, delicate grasses with abundant tufts of capillary basal leaves; panicles open, delicate; spikelets 2 mm. or less long; anthers 3 . . . *Agrostis bacillata*
- 58b. Coarse grasses, lacking capillary basal foliage; leaf blades elongated, often stiff and involute; panicles dense or spikelike; spikelets mostly more than 4 mm. long; anthers 1, 2, or 3 *Calamagrostis*
- 59a. Lemmas plainly 3-nerved, tapering to an acuminate apex; panicle dense, cylindrical, dark gray; rare; Chirripó Grande *Muhlenbergia nigra*
- 59b. Lemmas faintly 5-nerved, awnless or with dorsal awn; panicles open or dense; plants widespread at upper elevations *Agrostis*
- 60a. Culm internodes solid, pithy; spikelets arranged in 2 evident rows along rachis; fertile lemma greenish or tan, bearing an awn as long as or longer than body; plants widespread *Chloris*
- 60b. Culm internodes hollow; spikelets 2-rowed but overlapping and forming a single file; fertile lemma chocolate brown, nearly awnless; plants of sandy Caribbean beaches *Eustachys petraea*

KEY V

SPIKELETS DISARTICULATING FROM THE PEDICELS INDIVIDUALLY,
WITHOUT ATTACHED RACHIS OR BRISTLES

- 1a. Spikelets all alike in appearance, usually with perfect flowers 3
- 1b. Spikelets of 2 unlike kinds, frequently some abortive or unisexual 2
 - 2a. Inflorescence a single erect rame, bearing pairs of unlike spikelets; 1 of each pair long-awned, detachable, and perfect-flowered, the other awnless, persistent, and staminate; grasses of dry savannas *Trachypogon*
 - 2b. Inflorescence a panicle or raceme; spikelets awnless, all unisexual; plants of moist or marshy areas 43
- 3a. Spikelets when mature covered with hooked spines *Pseudoechinolaena polystachya*
- 3b. Spikelets not covered with hooked spines 4
 - 4a. Spikelets laterally compressed 5
 - 4b. Spikelets dorsally compressed or terete 17
- 5a. Spikelets borne in single raceme or spike 6
- 5b. Spikelets borne in panicle or cluster of spikes 8
 - 6a. First glume missing, second glume leathery, its lower margins united; floret 1 *Zoysia*
 - 6b. First glume present; margins of glumes not united; sterile lemma present below fertile floret 7
- 7a. Spike erect, slender; first glume about as long as spikelet .. *Mesosetum pittieri*
- 7b. Spike strongly reflexed, short and thick; first glume twice as long as rest of spikelet, tuberculate-hispid *Echinolaena gracilis*
 - 8a. Spikelets sessile, in slender or dense spikes 9
 - 8b. Spikelets pedicellate, in open or dense panicles 10
- 9a. Spikelets awned, in very slender spikes; delicate annual weed; Meseta Central *Arthraxon quarantinianus*
- 9b. Spikelets awnless, densely imbricated in stiff, short spikes; wiry perennial; coral beaches north of Limón *Spartina spartinae*
 - 10a. Spikelets concealed by long pinkish or silvery hairs *Rhynchelytrum repens*
 - 10b. Spikelets not concealed by hairs 11
- 11a. Spikelets with 2 bracts only (lemma and palea), glumes missing; lemma awnless *Leersia*
- 11b. Spikelets with 4 or more bracts; lemmas awned or awnless 12
 - 12a. Leaf blades borne on pseudopetioles *Zeugites*
 - 12b. Leaf blades lacking pseudopetioles 13
- 13a. Spikelets with numerous florets; tall, stout, stoloniferous grasses of sea beaches *Uniola pittieri*
- 13b. Spikelets with 1-2 florets; not sea beach grasses 14
 - 14a. Glumes longer than florets 15
 - 14b. "Glumes" (actually sterile lemmas) much shorter than floret *Oryza*
- 15a. Foliage densely velvety-hairy; florets 2 *Holcus lanatus*
- 15b. Foliage not velvety; floret 1 16
 - 16a. Glumes and lemma awned; rachilla not prolonged ... *Polypogon elongatus*

- 16b. Glumes and lemma awnless; rachilla prolonged behind palea
Cinna poaeformis
- 17a. Spikelets covered with long, dense, silky hairs 18
- 17b. Spikelets glabrous or pubescent, but not silky-hairy 20
- 18a. Inflorescence golden-brown *Eriochrysis cayanensis*
- 18b. Inflorescence white or grayish 19
- 19a. Both glumes longer than thin, delicate floret *Imperata*
- 19b. First glume much shorter than stiff, dark-colored floret *Digitaria insularis*
- 20a. Leaf blades broad, longitudinally pleated *Setaria*
- 20b. Leaf blades never pleated 21
- 21a. Each spikelet subtended by 1 or more stiff bristles (sterile branchlets); inflorescence a panicle 22
- 21b. Spikelets not subtended by sterile bristles, every branchlet ending in a spikelet; inflorescence a panicle or group of racemes 23
- 22a. Each spikelet subtended by a single bristle; spikelets with a broad papery wing when mature *Ixophorus unisetus*
- 22b. Each spikelet subtended by several-many bristles; spikelets never winged
Setaria
- 23a. Inflorescence a single 1-sided raceme on each peduncle 24
- 23b. Inflorescence of several-many racemes, or a panicle 25
- 24a. Spikelets in 2 or 4 longitudinal rows, their sterile lemmas facing outward; first glume present or absent *Paspalum*
- 24b. Spikelets in single longitudinal row, paired so that sterile lemmas of each 2 successive spikelets are facing each other; first glume present ... *Thrasya*
- 25a. Spikelets awnless, with hardened knob-like protrusion at base, formed of first glume and rachilla joint *Eriochloa*
- 25b. Spikelets awned or awnless, without basal knob-like protrusion; first glume evident or missing 26
- 26a. Spikelets awned or awn-tipped 27
- 26b. Spikelets blunt or acute, never awned 30
- 27a. Foliage densely covered with sticky hairs; plants aromatic . *Melinis minutiflora*
- 27b. Foliage not sticky-hairy; plants not aromatic 28
- 28a. Plants decumbent or stoloniferous; leaf blades short, lanceolate or elliptical
Oplismenus
- 28b. Plants not stoloniferous; leaf blades linear 29
- 29a. Spikelets narrow, with pointed basal callus; both glumes long-awned
Chaetium bromoides
- 29b. Spikelets ovoid, blunt at base; glumes not long-awned *Echinochloa*
- 30a. Spikelets with 2 fertile florets, nearly spherical *Isachne*
- 30b. Spikelets with a perfect terminal floret, lower floret staminate or sterile . 31
- 31a. Spikelets borne in panicles 36
- 31b. Spikelets borne in 1-sided spikelike racemes, all on lower sides of flattened or triangular rachises 32
- 32a. Backs of fertile lemma and second glume turned toward rachis 33
- 32b. Backs of fertile lemma and second glume turned away from rachis 35
- 33a. Fertile floret soft and flexible, edges of lemma thin, exposed *Digitaria*

- 33b. Fertile floret rigid, edges of lemma inrolled and concealed 34
 34a. Fertile lemma smooth; spikelets plano-convex; first glume small or absent
Paspalum
 34b. Fertile lemma transversely corrugated; spikelets with rounded edges; first
 glume well developed 44
 35a. First glume well developed; spikelet with 3 bracts below fertile floret; fertile
 lemma corrugated *Brachiaria*
 35b. First glume absent; spikelet with 2 bracts below fertile floret; fertile lemma smooth
Axonopus
 36a. Spikelets with 2 bracts below fertile floret, first glume missing
Leptocoryphium lanatum
 36b. Spikelets with 3 bracts below fertile floret, first glume present 37
 37a. Spikelets placed very obliquely on tip of pedicel, rotund, turning black when
 mature; second glume and florets with minute tufts of hairs at tip; some species
 with woody culms *Lasiacis*
 37b. Spikelets not obliquely placed on pedicel; florets lacking tufts of hairs at tip; culms
 not woody 38
 38a. Fertile lemma with small, fleshy blisters, which leave scar-like depressions in
 drying, along its edges at base *Ichnanthus*
 38b. Fertile lemma lacking blisters or scars along its edges 39
 39a. Panicles dense, cylindrical and spikelike 40
 39b. Panicles more or less open, not spikelike 41
 40a. Spikelets strongly inflated or bulging on second glume side; blades narrow;
 culms less than 1 m. tall *Sacciolepis*
 40b. Spikelets not inflated; blades very wide, with prominent cordate bases; culms
 usually 2-3 m. tall *Hymenachne*
 41a. Both glumes as long as the pointed spikelet *Homolepis aturensis*
 41b. First glume shorter than spikelet 42
 42a. Fertile lemma with a laterally flattened, beaklike tip . *Acroceras zizanioides*
 42b. Fertile lemma rounded to tip, without beak *Panicum*
 43a. Leaf blades linear, elongated, acuminate, lacking pseudopetioles; aquatic or marsh
 plants *Luziola*
 43b. Leaf blades narrowly triangular, blunt-tipped, less than 5 × longer than wide,
 borne on short pseudopetioles *Olyra*
 44a. Leaf blades ovate, 4-5 times longer than wide, base cordate; racemes divaricate,
 few; rachis of each raceme terminating in a spikelet *Urochloa*
 44b. Leaf blades linear, many times longer than wide, not cordate; racemes appressed
 to rachis, many; rachis of each raceme terminating in a flattened
 sterile tip *Paspalidium*

KEY VI

SPIKELETS ALL OR SOME FALLING IN CLUSTERS OF TWO OR MORE, OR ATTACHED TO RACHIS INTERNODES, PEDICELS, OR BRISTLES (REDUCED BRANCHLETS OR ABORTIVE SPIKELETS)

- 1a. Inflorescences usually arising directly from soil on short, leafless peduncles, club shaped, disarticulating into individual internodes, each bearing 3 flattened bracts,

each with 2 minute staminate spikelets, and concealing within them a slender rachis and a solitary sessile pistillate spikelet; rain forests, Caribbean lowlands

Pariana parvispica

- 1b. Inflorescences all borne on leafy culms, various but never as in 1a. 2
 - 2a. Inflorescence a slender simple panicle, each branch reduced to single stiff unbranched bristle that falls from rachis at maturity, bearing a single appressed permanently attached spikelet near its base *Paratheria*
 - 2b. Inflorescence various, but never with simple deciduous branches, each bearing solitary spikelet 3
- 3a. Inflorescence a dense cylindrical bristly panicle; each spikelet or spikelet group surrounded by ring of long stiff bristles (reduced branchlets), with which it falls from the persistent rachis *Pennisetum*
- 3b. Spikelets not surrounded by elongated bristles; inflorescence a panicle or group of spikes, rames, or spikelet fascicles 4
 - 4a. Rachis of individual spike or rame disarticulating into individual internodes at maturity, each carrying spikelets with it 9
 - 4b. Rachis remaining intact, spikelet groups falling from it, or entire inflorescence falling 5
- 5a. Inflorescence a single cylindrical or flattened spike or rame, without visible branches 6
- 5b. Inflorescence a raceme of spikelet fascicles or short 1-sided spikes 7
 - 6a. Rachis flattened, corky, spikelets acute, sunken into 1 side of the rachis; leaves subopposite in pairs; sheaths strongly keeled
Stenotaphrum secundatum
 - 6b. Rachis thin, truncate spikelets closely overlapping and surrounding it; leaves alternate *Eremochloa ophiuroides*
- 7a. Spikelets borne in short, 1-sided spikes of more than 3 spikelets *Bouteloua*
- 7b. Spikelets borne in fascicles of 1-3, often with short attached bristles 8
 - 8a. Spikelets 1-2 in each cluster, accompanied by bristles (reduced or abortive spikelets) *Pentarraphis annua*
 - 8b. Spikelets 3 in each cluster, all pedicellate; sterile bristles absent
Aegopogon cenchroides
- 9a. Sessile spikelets laterally compressed, glumes keeled 10
- 9b. All spikelets dorsally compressed or spherical, glumes not keeled 12
 - 10a. Spikelets awnless, members of each pair equal; inflorescence a large terminal panicle of verticillate rames; plants up to 2 m. tall, in dense, hard clumps *Vetiveria zizanioides*
 - 10b. Spikelets awned, the pedicellate one absent or different from the sessile one; inflorescence not a large panicle 11
- 11a. Spikelets solitary, the lowermost ones sometimes accompanied with a minute pedicel; low, creeping plants with short, cordate leaf blades
Arthraxon quartinianus
- 11b. Spikelets paired, dimorphic, pedicellate ones enlarged and flattened; plants erect; leaf blades linear *Diectomis*
- 12a. Inflorescence silky-hairy, abundant hairs exceeding and concealing spikelets 13
- 12b. Inflorescence not silky-hairy, spikelets easily visible 14

- 13a. Inflorescence open, pyramidal; hairs white *Saccharum officinarum*
- 13b. Inflorescence dense, cylindrical (like *Typha*); hairs golden-brown
Eriochrysis cayanensis
- 14a. Spikelets, or some of them, sunken into hollows of thickened cylindrical rachis 15
- 14b. Spikelets never sunken into thin or partially thickened rachis internodes . 17
- 15a. Spikelets all unisexual, lower part of each inflorescence made up of a series of bony cylindrical internodes, each containing single pistillate spikelet; upper portion flattened, bearing paired staminate spikelets *Tripsacum*
- 15b. Sessile spikelet of each pair with a perfect flower; inflorescence not as in 14a. 16
- 16a. Rachis internode united with edge of the pedicel; pedicellate spikelets sterile; foliage bristly-hispid, irritating to touch *Rottboellia exaltata*
- 16b. Rachis internode not united with pedicel, pedicellate spikelet sometimes with a flower; foliage not bristly *Coelorachis aurita*
- 17a. Rames 1 on each peduncle (but culms sometimes bearing several to many peduncles, interspersed with bracts) 18
- 17b. Rames 2-many on each peduncle, forming an inflorescence 21
- 18a. Low, creeping stoloniferous grass; spikelets equal, in pairs or trios, at each node of rachis *Polytrias amaura*
- 18b. Plants not low and creeping; spikelets in pairs, the sessile one fertile, usually awned, the pedicellate spikelet much reduced and sterile 19
- 19a. Sessile spikelets spherical, 1-2 mm. in diameter, hard, black, rough and ridged, awnless *Hackelochloa granularis*
- 19b. Sessile spikelets ovate, acute, never spherical, awned or awnless 20
- 20a. Sessile spikelets perfect-flowered, usually awned; pedicellate spikelets reduced, sterile *Schizachyrium*
- 20b. Sessile spikelets pistillate, awnless; pedicellate spikelets staminate, awnless, as large as sessile ones *Hypogynium virgatum*
- 21a. One spikelet of each pair sessile 22
- 21b. Both spikelets of each pair pedicellate and usually alike; pedicels of unequal length
Ischaemum
- 22a. First glume strongly cross-wrinkled; lower floret staminate .. *Ischaemum*
- 22b. First glume not cross-wrinkled; lower floret sterile, represented by an empty lemma 23
- 23a. Rachis segment and pedicels with thick margins and a very thin, translucent center line; first glume of sessile spikelets 5-9-nerved 24
- 23b. Rachis segments and pedicels not thin in center; first glumes of sessile spikelets usually 2-5-nerved 25
- 24a. First glume of sessile spikelets with conspicuous circular pit in the center; rames sessile in fan-shaped cluster, spikelet-bearing to their bases
Bothriochloa
- 24b. First glume of sessile spikelets lacking a pit; rames borne individually on slender weak peduncles along central rachis *Euclasta*
- 25a. Foliage strongly lemon-scented; plants very rarely blooming
Cymbopogon citratus
- 25b. Foliage not lemon-scented; annual bloomers 26

- 26a. Individual rames of numerous pairs of spikelets 28
 26b. Individual rames numerous, of 1-7 segments (spikelet pairs), borne on lateral branches of large terminal, bractless panicle 27
 27a. Pedicellate spikelets present but awnless *Sorghum*
 27b. Pedicellate spikelets absent, only hairy pedicels present *Sorghastrum*
 28a. All pairs of spikelets of each rame alike, each with a fertile sessile spikelet *Andropogon*
 28b. Lowermost 1 or 2 pairs of spikelets of each rame awnless, staminate or sterile, others with perfect-flowered, awned sessile spikelets and awnless or rudimentary pedicellate spikelets *Hyparrhenia*

ACIACHNE Benth

REFERENCES: Agnes Chase, *Aciachne*, a cleistogamous grass of the high Andes, J. Wash. Acad. Sci. 14:364-366. 1924. J. Reeder & C. Reeder, *Parodiella*, a new genus of grasses from the high Andes, Bol. Soc. Argent. Bot. 12:268-283. 1968.

Low, pungent cushion grasses of high altitudes. Inflorescence a short spike of 1-3 spikelets, mostly hidden among the leaves. Glumes obtuse, equal, stiff, the first 3-5-nerved, the second 5-nerved; nerves evident; disarticulation above the glumes; floret 1; lemma faintly 3-nerved, indurate, smooth and shining, tapering into a short, stiff, awn-like tip; callus blunt; palea about as long as the body of the lemma; lodicules 3, dimorphic, the broader pair each 1-nerved; third lodicule solitary, spatulate, nerveless.

One species, restricted to the páramos of high mountains, mostly in the Andes. The genus is closely related to *Lorenzochloa*, which occurs in similar habitats. (Pooideae: Stipeae.)

***Aciachne pulvinata* Benth**, in Hook., Icon. Pl. 14:44, pl. 1362. 1880. Figure 1.

Perennial, forming low cushions, 1-3 cm. high; culms much-branched; internodes very short, concealed by the densely overlapping sheaths; sheaths thin, hyaline, 3-5-nerved, somewhat gaping; ligule stiff, erect, truncate, scabrid on the back, ca. 0.7 mm. long, decurrent onto the sheath margins; blades numerous, forming a pungent fan-shaped cluster near the culm apex, folded, 4-10 mm. long, terete, glabrous beneath, erect or slightly recurved, with a pungent tip; upper surface with abundant short, peg-like hairs; blade in cross-section with a thick, continuous sclerenchyma layer covering the entire external surface and the edges of the upper epidermis; vascular bundles 3; mesophyll somewhat radially arranged, densely packed; prophylla prominent, stiff, the keels exerted as 2 pungent teeth. Inflorescence scarcely exceeding the foliage, a short spike of 1-3 spikelets. Glumes obtuse, stiff, evidently nerved; lemma stiff, faintly 3-nerved, smooth and shining, tapering to a short awnlike tip; palea nearly as long as the lemma; anthers 3; style branches 2, separate. Chromosome number $2n = 22$ (Reeder & Reeder, 1968).

The only Central American collection of this species is the following: Prov. San José: Valle de los Conejos, Chirripó Massiv, 3,500 m., 16

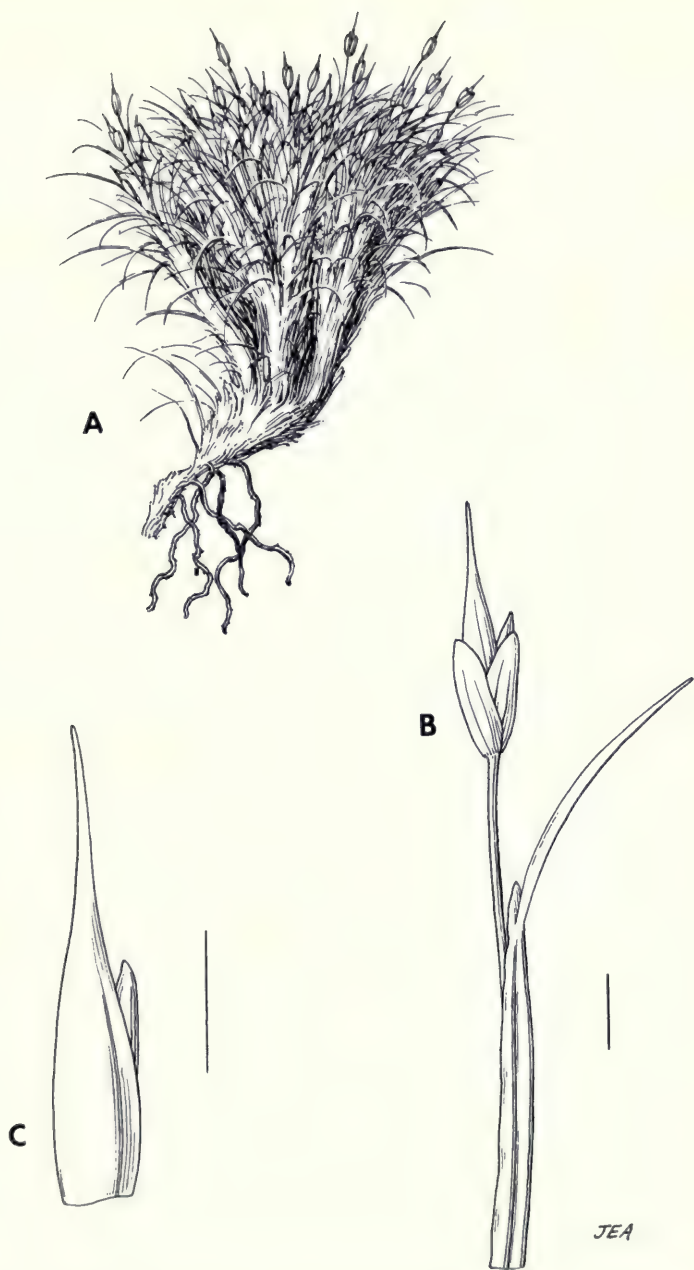


FIG. 1. *Aciachne pulvinata*. A, portion of a matted plant; B, spikelet; C, floret.

March 1971. *H. Kuhbier 0393* (BREM, CR, ISC). High mountains of southern Costa Rica; Venezuela, Peru, and Bolivia.

The occurrence of *Aciachne* along with two other xeromorphic grasses of Andean distribution, *Lorenzochloa erectifolia* and *Stipa hans-meyeri*, on the high páramos of Chirripó Grande in Costa Rica, poses a difficult question as to the manner of migration of these and many other high-altitude páramo plants that occur in both Central America and the Andes.

ACROCERAS Stapf in Prain

Sprawling annuals and perennials, the culms rooting at the lower nodes; inflorescence a panicle. Spikelets large, apiculate, the glumes and sterile lemma with pronounced crest-like keels at their tips; first glume nearly as long as the spikelet, 3-5-nerved; second glume and sterile lemma equal, 5-nerved; sterile lemma with a well-developed palea; fertile lemma rigid, smooth, with a laterally flattened herbaceous green beak, a circular depressed area on the back above the base; margins of lemma thickened but not involute; palea flat, rigid, with a small flattened bidentate herbaceous beak at its tip; rachilla thick and indurate, with definite internodes between the glumes and between the second glume and the sterile lemma.

Acroceras is a small genus of tropical grasses, widespread in Africa and Asia. *Acroceras zizanioides* appears to be the only species found in the Americas, where it may have been introduced. The genus is somewhat similar to the endemic American *Lasiacis*, but the resemblances may be coincidental. (Panicoideae: Paniceae.)

Acroceras zizanioides (H.B.K.) Dandy, J. Bot. 69:54. 1931. *A. oryzoides* Stapf in Prain, Fl. Trop. Africa 9:622. 1920. *Panicum oryzoides* Swartz, Prodr. Veg. Ind. Occ. 23. 1788, not *P. oryzoides* Ard., Animadv. Spec. Alt. 16, pl. 5. 1764. *P. zizanioides* H.B.K., Nov. Gen. & Sp. 1:100. 1816. Figure 2.

Duration indefinite; plants sprawling or scrambling, rooting at the lower nodes; culms up to 2 m. long, the tips ascending; branching freely at lower nodes; culms glabrous, smooth, thick-walled, hollow; nodes glabrous or papillose-hispid. Sheaths shorter than the internodes, glabrous or papillose-hispid, especially near the apex; exposed margin of sheath papillose-hispid; ligule 0.2-0.5 mm. long, membranaceous; blades cordate at the base above a short pseudopetiole, glabrous or nearly so, sometimes papillose-hispid on the basal lobes of the blade, collar, and midrib above the base. Inflorescence terminal on the main culm or on leafy branches; panicles open, with few rather simple ascending branches, 9-35 cm. long, 2-10 cm. wide, mostly 2-4 times longer than wide. Spikelets mostly paired, one short pedicellate and the other longer pedicellate, on angular pedicels, appressed along the main panicle branches; spikelets dorsally compressed, elliptic-ovate, 5.5-6.6 mm. long, glabrous; first glume 4.0-5.4 mm. long, ovate, 3-5-nerved, clasping the second glume; second glume 5-6 mm. long, 5-nerved; lower (sterile) lemma 4.5-5.4 mm. long, 5-nerved; palea 3.5-4.0 mm. long; anthers purple, 2 mm. long;

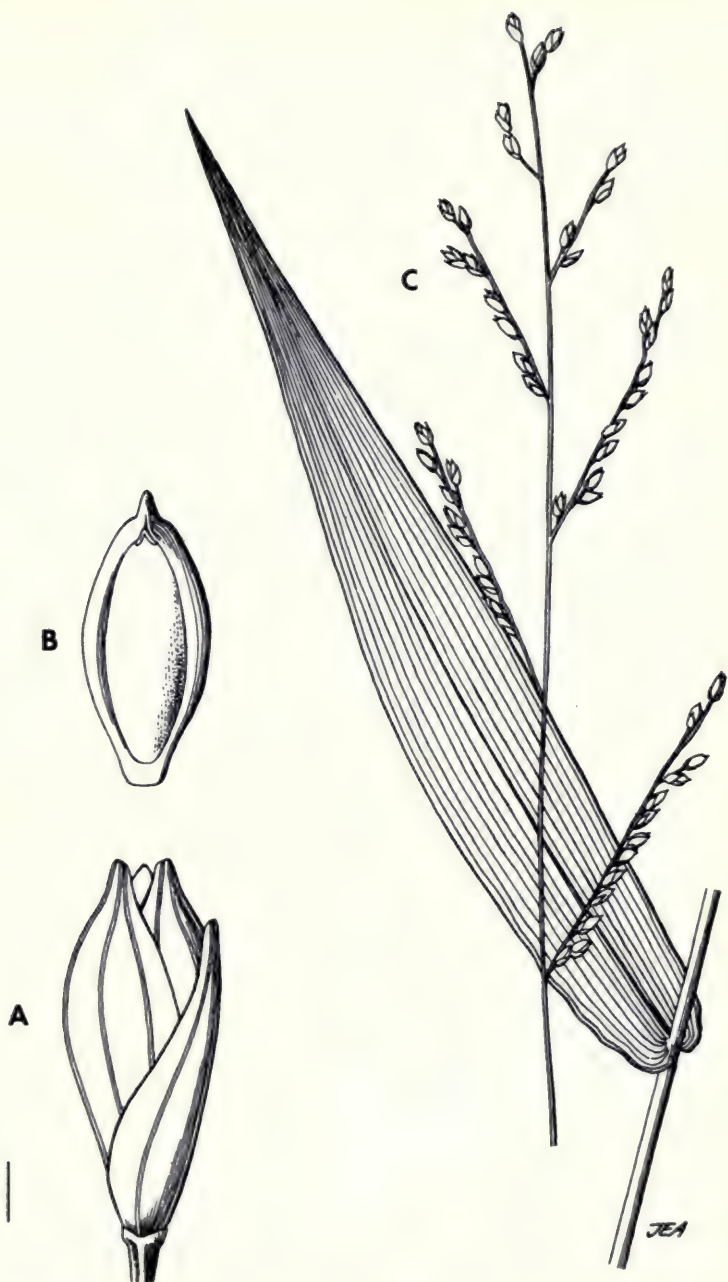


FIG. 2. *Acroceras zizanioides*. A, spikelet; B, fertile floret; C, panicle.

fertile floret 4.5-5.0 mm. long, palea with 2 marginal triangular membranaceous flanges just above the base. Chromosome number from Costa Rican specimens, $n = 18$.

Common on shaded riverbanks and forest margins, shaded roadsides; mostly below 100 m. but occasionally to 1,100 m.; Caribbean and Pacific slopes; June to December, possibly yearlong. Southern Mexico to northern Argentina; West Indies; Tropical Africa.

AEGOPOGON Humboldt & Bonpland ex Willdenow

REFERENCE: A. A. Beetle, The genus *Aegopogon* Humb. & Bonpl., Univ. of Wyoming Publications XIII:17-23. 1948.

Delicate sprawling or stoloniferous grasses; inflorescence a unilateral raceme of detachable triads of spikelets, the triads borne on short persistent branchlets, in 2 rows along 2 sides of a triquetrous rachis; triad deciduous as a group, with a short segment of the branch below as a hairy stipe; each triad with 1 short-pedicellate or subsessile fertile spikelet and 2 longer-pedicellate sterile or staminate ones; fertile spikelet 1-flowered; glumes equal, shorter than the floret, awned from a bifid apex; lemma 5-lobed, the 2 marginal lobes nerveless, membranaceous, the 3 prominent nerves each extending into an awn, the 2 lateral awns much shorter than the central one; palea about as long as the lemma, the nerves extending into awns; rachilla not extended beyond the floret.

Aegopogon is a small genus of American grasses, found in warm, dry regions from the southwestern United States to South America. It is most closely related to *Pentarraphis* and *Bouteloua*. (Chloridoideae: Chlorideae.)

KEY TO SPECIES OF *Aegopogon*

- 1a. Glumes oblong, narrow, lateral lobes acute; ligules 1.5-4.5 mm. long
Ae. cenchroides
- 1b. Glumes flabellate, lateral lobes broadly rounded; ligules 0.7-1.5 mm. long
Ae. tenellus

***Aegopogon cenchroides* Humb. & Bonpl. ex Willd., Sp. Pl. 899. 1806. Figure 3.**

Duration indefinite; plants sprawling, the culms rooting at the nodes, forming large patches; erect portions of culms 3-30 cm. long; branching abundant from the trailing culms; prophylla pointed, ciliate on the keels, 7-15 mm. long; culms 0.2-0.3 mm. thick, hollow, glabrous; sheaths much shorter than the internodes, glabrous to puberulent; ligules 1.5-4.5 mm. long, membranaceous; blades 2-10 cm. long, 1-2 mm. wide, glabrous, scabrous, or puberulent; peduncle slender, exserted 3-10 cm.; inflorescences solitary, terminal on the erect culm branches, 2-9 cm. long; spikelet triads in 2 rows, but usually oriented in one direction; stalk of the spikelet triad ca. 0.2 mm. long, bearded; pedicel of fertile spikelet ca. 0.3 mm. long, those of the sterile pair 0.4-0.7 mm. long; sterile spikelets range from nearly as long as the fertile one to minute rudiments; fertile spikelet 3.7-5.5 mm. long, excluding the central awn; glumes subequal, 3-9 mm., narrowly oblong, the apex bifid, the lobes acute, the awn making up half or more of the total

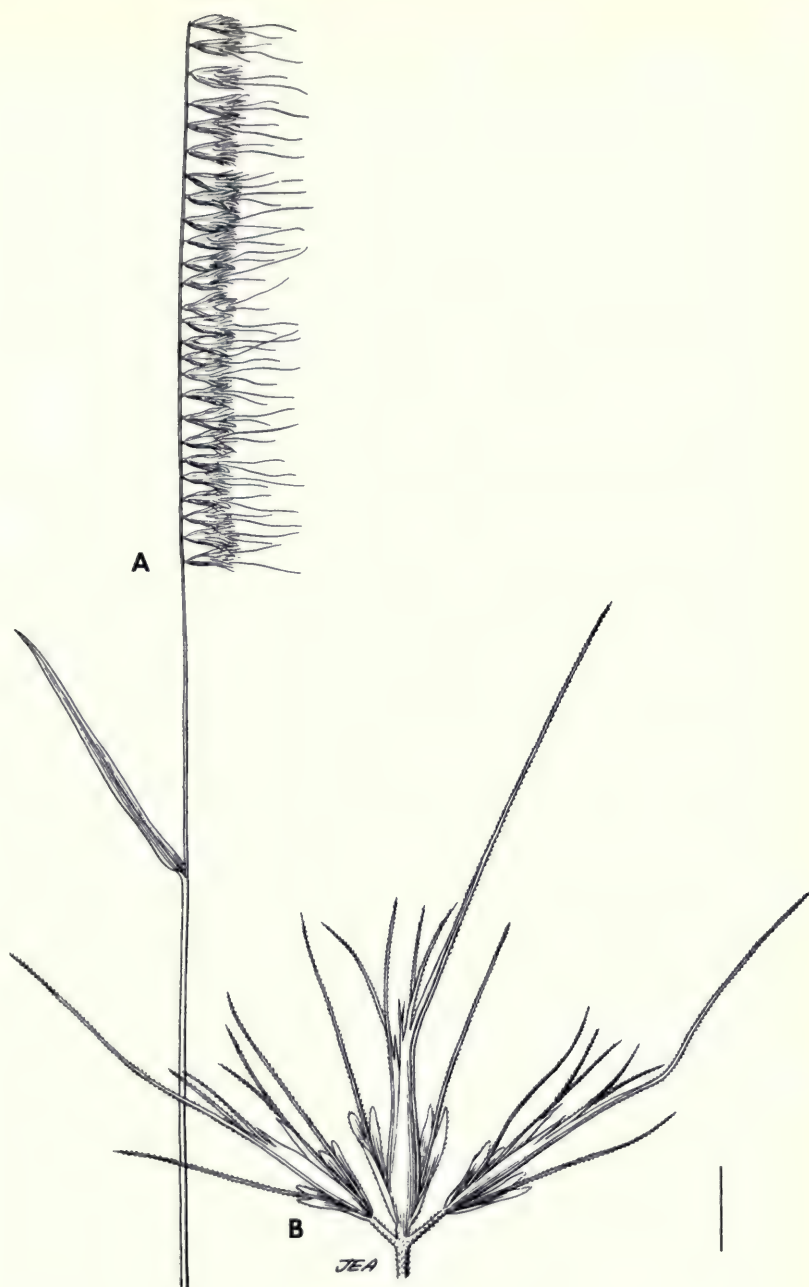


FIG. 3. *Aegopogon cenchroides*. A, inflorescence; B, triad of spikelets.

length; lemma glabrous, membranaceous, lanceolate, the undivided portion 1.5-2.5 mm. long, the lateral awns 1.5-2.5 mm. long, the central awn 3.5-8.5 mm. long; palea 2.5-5.2 mm. long, including keel awns up to 1 mm. long; anthers 3, 0.5-2.0 mm. long, yellow. Chromosome numbers, from Costa Rican material, $n = 20, 40$. Hexaploids with $n = 30$ are also known.

Road embankments and open slopes, mid elevations from 1,400-2,700 m., volcanoes of the Meseta Central; Cordillera de Talamanca. June to December. Mexico to Colombia and Venezuela.

The spikelets are extremely variable in awning and in the degree of development of the two sterile lateral spikelets, which range from sterile rudiments to a few which are either staminate or pistillate. The extreme morphological variability of our material does not appear to be correlated with the ploidy level. This small genus obviously needs further study.

Aegopogon tenellus (DC.) Trin., Gram. Unifl. 164. 1824. *Lamarckia tenella* DC., Cat. Hort. Monspel. 120. 1813.

Duration indefinite; culms sprawling and rooting at the nodes, the erect flowering portions 10-30 cm. long; branching abundant from the decumbent portions; prophylla 10-12 mm. long, ciliate on the keels; culms 0.5 mm. or less thick, hollow, glabrous; nodes dark colored, glabrous; sheaths shorter than the internodes, glabrous or sparingly hirsute; ligule a lacerate membrane, 0.7-1.5 mm. long; blades 1-7 cm. long, 1-2 mm. wide, glabrous or puberulent; inflorescence a unilateral raceme of spikelet triads, 2-5 cm. long, linear; pedicels of spikelets 1.0-1.5 mm. long, bearded; spikelets laterally compressed, 4.5-5.5 mm. long, excluding the central awn; glumes 4.0-4.5 mm. long, 1-nerved, flabellate, with a broad cordate apex, the midrib occasionally bearded near the base; undivided portion of lemma ca. 2.5 mm. long; lateral awns ca. 2.5 mm. long, the central one ca. 11 mm.; palea ca. 4.5 mm. long, including awns ca. 2 mm. long; anthers 3, 0.6 mm. long, tan.

The above measurements are taken from well-developed spikelets. Many specimens show much reduced spikelets, often with reduced awns (var. *abortivus* (Fourn.) Beetle). This species is known from Costa Rica only by the following specimen: Prov. de San José, Vicinity of Santa Maria de Dota, alt. 1,500-1,800 m., *Standley 41720*. Southern Arizona to Costa Rica.

AGROPYRON Gaertner

Caespitose or rhizomatous perennial grasses; inflorescence a solitary terminal balanced spike, the spikelets solitary at each node of the thin rachis and laterally appressed to it. Glumes equal, several-many-nerved; florets several; disarticulation above the glumes and between the florets; lemmas 5-7-nerved, awnless or awned from the tip; palea nearly as long as the lemma.

A large genus in temperate and cold regions of both Old and New Worlds, much rarer in the southern hemisphere. The genus is closely related to *Elymus*, *Triticum*, *Secale*, *Hordeum*, etc. (Pooideae: Triticeae). Compare also *Brachypodium*, which has similar inflorescence and spikelets, but the individual spikelets on short pedicels.

Agropyron attenuatum (H.B.K.) Roem. & Schult., Syst. Veg. 2:751. 1817. *Triticum attenuatum* H.B.K., Nov. Gen. & Sp. 1:180. 1816. Figure 4.

Perennial, 1-2 m. tall; culms erect, unbranched, the bases decumbent or rhizomatous; internodes glabrous, 2-3 mm. thick, thin-walled; nodes dark, contracted; sheaths mostly overlapping, striate, slightly puberulent near the apex; ligule firm, membranaceous, 0.7 mm. long, continuous with the membranaceous sheath margin; blades up to 20 cm. long, 2-5 mm. wide, glabrous or puberulent above and below; uppermost blade reduced. Spike 11-14 cm. long, 5 mm. wide, the spikelets longer than the internodes and overlapping; rachis internodes thin, flat, scabrid on the angles, 6-7 mm. long. Spikelets 15-17 mm. long, laterally compressed; glumes equal, lanceolate or narrowly ovate, acute, flat, overlapping on the abaxial side of the spikelet, 11 mm. long, 5-7-nerved; florets 3-5, the terminal one rudimentary; lemmas lanceolate, 9-13 mm. long, rounded on the back, scabrid; awn lacking or up to 1.5 mm. long; palea 9-10 mm. long, scabrid on the keels; rachilla segments thick, 2.5-2.8 mm. long, the scar of disarticulation very oblique; anthers 3, 2.5 mm. long, yellow; ovary with a large deltoid pubescent appendage.

Rare, páramos near summit of Chirripó Grande. This is the only North American locality for this species, previously known only from the Andes of Ecuador, Peru, and Bolivia. November-April.

This species can easily be confused with *Brachypodium mexicanum*, which occurs in the same area. The *Brachypodium* has short pedicels, 1-3 mm. long, whereas the spikelets of *Agropyron* are sessile or nearly so.

AGROSTIS Linnaeus

Mostly perennial grasses of temperate climates; plants caespitose, rhizomatous, or stoloniferous. Inflorescence a terminal panicle; spikelets numerous, small, laterally compressed; glumes nearly equal or the first slightly longer than the second, both exceeding the single floret; disarticulation above the glumes; lemma thin, faintly 3-5-nerved, the tip blunt or narrow, sometimes minutely toothed; callus often minutely bearded; lemma occasionally bearing a straight or geniculate awn; palea in various species absent, minute, or well developed; rachilla in one of our species (*A. bacillata*) produced behind the palea as a minute bristle, otherwise absent; anthers 3.

Agrostis is a large genus of temperate and cold climates, in the tropics confined to high altitudes. The spikelets are similar to those of *Calamagrostis*, which differs in the possession of abundant callus hairs and a prolonged, usually hairy rachilla. (Pooideae: Agrostideae.)



FIG. 4. *Agropyron attenuatum*. A, spike; B, spikelet; C, a single floret.

KEY TO SPECIES OF *Agrostis*

- 1a. Rachilla extended beyond base of palea as a bristle; lemmas awned or awnless
A. bacillata
- 1b. Rachilla not evident beyond base of the palea 2
 - 2a. Palea at least half as long as lemma 3
 - 2b. Palea absent or less than half as long as lemma 5
- 3a. Ligule of innovations less than 1 mm. long, those of culm leaves up to 2 mm.
A. tenuis
- 3b. Ligules mostly 3-8 mm. long 4
 - 4a. Erect, rhizomatous plants *A. gigantea*
 - 4b. Trailing, mat-forming stoloniferous plants *A. stolonifera* var. *palustris*
- 5a. Panicles narrow or spike-like, 5-10 × longer than wide, usually less than 1 cm. wide; basal leaf blades capillary, less than 1 mm. wide 6
- 5b. Panicles open or diffuse, branches spreading, at least during flowering 7
 - 6a. Panicles dense, the rachis mostly concealed; pedicels shorter than spikelets; palea absent; awn twisted and geniculate; Cordillera de Talamanca
A. toluensis
 - 6b. Panicles narrow but loose, rachis partly exposed; pedicels once to twice as long as spikelets; palea ca. 1 mm. long; awn straight; around summit of Volcan Poás
A. pittieri
- 7a. Plants with abundant basal foliage, leaf blades narrow, flat or folded; palea absent; awn present or absent 8
- 7b. Plants lacking conspicuous basal foliage; panicles very lax and much-branched; palea minute; awn minute or absent *A. perennans*
 - 8a. Spikelets ca. 2 mm. long; lemma 1.2-1.4 mm. long, awnless or with a minute awn just below apex *A. turrialbae*
 - 8b. Spikelets 2.9-3.7 mm. long; lemma 1.7-2.2 mm. long; awn inserted below middle of back, twisted and geniculate, exerted *A. subpatens*

***Agrostis bacillata* Hack., Oesterr. Bot. Z. 52:59. 1902. Figure 7.**

Delicate, densely tufted perennial, 10-30 (-50) cm. tall; foliage mostly basal; culms erect, unbranched, glabrous, ca. 0.2-0.3 mm. thick, with 1-2 shorter internodes above the base, the terminal internode (peduncle) the longest; nodes purple; sheaths nearly as long as the internodes; ligule a thin white membrane, 1.7-4.3 mm. long, tapering to an acute apex; leaf blades 2-15 cm. long, 0.2-0.3 mm. thick as folded, stiffish and erect, minutely scabrous on the lower surface, tightly folded; upper surface with a few coarse ridges. Peduncle exerted 2-6 cm.; inflorescence solitary, terminal, an open cylindrical delicate panicle, 4-11 cm. long, 3-5 cm. wide; branches delicate, mostly paired, thin and flexuous, bearing spikelets on their outer half; pedicels spreading, longer than the spikelets. Spikelets 1.8-2.0 mm. long, the glumes equal or the second slightly shorter than the first, spreading apart at the tips, 3-nerved, ovate 4.5:1 as folded, acute, usually purple, the keel slightly scabrid; lemma ovate-obovate 3:1 as folded, 5-nerved, the apex blunt; a thin awn sometimes present, 0.3-0.6 mm. long, inserted on the back of the lemma ca. one-third below its tip; palea 1.1-1.4 mm. long; anthers 3, purple, 0.8-1.0 mm. long; rachilla prolonged behind the palea as a slender naked bristle, 1.1-1.4 mm. long. Chromosome number $n = 14$ from a Costa Rican specimen.

Páramos above 3,000 m. elev.; Asunción, Cerro de las Vueltas, Chirripó Grande, above Llano Grande on Irazú. Apparently blooming yearlong. Endemic to Costa Rica. The type, *Pittier 10477*, was collected on the Cerro de la Muerte.

This species is unusual in the genus *Agrostis* by its possession of a rachilla internode extended beyond the floret. In this it resembles species of *Calamagrostis*, which differ in having unequal glumes and prominent callus hairs.

Agrostis gigantea Roth, Tent. Fl. Germ. 1:31. 1788. *Agrostis alba* Auth., non L.

Vigorous rhizomatous perennial; plants 40-120 cm. tall, erect or the culm bases decumbent in wet sites; culms unbranched or branched from the lower nodes, glabrous, hollow; nodes glabrous; sheaths glabrous; ligule a thin white membrane, usually 3-6 mm. long, lacerate at the tip. Peduncle slender, exserted; inflorescence a solitary terminal panicle, 8-25 cm. long, 3-15 cm. wide, ovoid-pyramidal, usually rather open; branches fascicled, of various lengths; spikelets clustered, the pedicels usually shorter than the spikelet. Spikelets 2-3 mm. long; first glume ovate, acute, 1-nerved, longer than the similar second glume; glumes scabrous on the keel; lemma ca. 2 mm. long, ovate, acute, faintly 3-5-nerved; callus minutely bearded, tip blunt, usually awnless; palea ca. half as long as the lemma, with 2 faint vascular bundles; anthers 3, yellow, 1.0-1.5 mm. long.

Moist pastures and roadsides; volcanoes of the Meseta Central, above 2,000 m. Blooming yearlong.

This species is a cool-climate pasture grass of European origin. Its occurrence in dairy pastures on the volcanoes suggests that it was introduced in pasture seed mixtures, along with other European species. Two similar species, *A. stolonifera* and *A. tenuis*, occur in the same types of habitats. This species has consistently been called *A. alba* in American literature for many years. However, European authors universally reject that name. The panicles have a reddish or brownish tinge when well developed, hence the English common name, "redtop."

Agrostis perennans (Walt.) Tuckerm., Amer. J. Sci. 45:44. 1843. *Cornucopiae perennans* Walt., Fl. Carol. 74. 1788. An extensive synonymy is given in Hitchcock, Man. Gr. U.S., ed. 2. 1950. Figure 5.

Weak, somewhat decumbent caespitose perennial; culms up 100 cm. long, unbranched or branching only from the base; internodes glabrous, hollow, 0.7-1.0 mm. thick; sheaths glabrous, ridged, shorter than the elongated internodes; ligule a thin, lacerate membrane, decurrent on the sheath margins, 2-5 mm. long; leaf blades flat, 6-13 cm. long, 1.5-3.0 mm. wide, ridged, scaberrulous. Peduncle slender, exserted 8-15 cm.; inflorescence a solitary terminal panicle, 11-15 cm. long, 6-11 cm. wide, open and delicate, ovoid-pyramidal; branches up to 7 per node, including some solitary elongated pedicels;



FIG. 5. *Agrostis perennans*. A, panicle; B, spikelets; C, floret.



FIG. 6. *Agrostis* species. A. *turrialbae*: A, panicle; A. *tolucensis*: B, plant, C, spikelet, D, floret; A. *pittieri*: E, panicle, F, spikelet, G, floret.

branches delicate, flexuous, rebranching at or below the middle; pedicels all spreading, longer than the spikelets. First glume 2.2-2.9 mm. long, 1-nerved, ovate, caudate, the tip slightly keeled; midrib scabrous; second glume similar, shorter, 1.9-2.3 mm. long; lemma ovate, 1.7-1.8 mm. long, very faintly nerved; callus appearing glabrous except under high magnification, tip erose or bifid, occasionally with a minute awn from the bifid apex; palea minute, nerveless; anthers 3, purple, 0.8-1.0 mm. long.

Forests and páramos, 2,900-3,300 m. elevation, Asunción, La Geor-gina, and other scattered localities on the Cordillera de Talamanca. June to August.

Our plants seem similar to the woodland phase of *A. perennans* from the United States; however, three of our specimens for which we have chromosome counts indicate a number of $n = 14$, whereas counts from temperate North America show $n = 21$. A single count from Mexico by Dr. Reeder also indicates $n = 14$. *Agrostis laxissima* Swallen from Guatemala appears very similar to our plants, but has a well-developed awn. *Agrostis turrialbae*, which is regarded as endemic to Costa Rica, is similar to *A. perennans*, differing in the possession of abundant basal foliage. Its chromosome number is not yet known. This complex of species needs detailed morphological and cytological study.

***Agrostis pittieri* Hack., Oesterr. Bot. Z. 52:60. 1902. Figure 6.**

Perennial, 30-60 cm. tall, in dense tufts with numerous intravaginal innovations; culms erect, 0.5-1.0 mm. thick, the internodes glabrous; culm nodes purple; internodes 3, 2 shorter internodes at the base of the culm, the peduncle longer; foliage mostly basal; sheaths glabrous or slightly scabrous toward the apex; ligule a thin membrane, 2.5-3.5 mm. long; basal blades 7-15 cm. long, 0.6-1.0 mm. wide, folded, minutely scabrous on the lower surface, coarsely ridged above; culm blades usually shorter and not folded. Inflorescence a solitary terminal panicle, 9-11 cm. long, narrow but loose, 0.5-1.0 cm. wide, relatively few-flowered; branches slender, erect, 2-many from each node; pedicels erect, scabrous, 1-2 $\times$ as long as the spikelet. Spikelets laterally compressed; glumes 1-nerved, purplish toward the tips, scabrous on the keels; first glume 2.9-3.9 mm. long; second slightly shorter, 2.8-3.4 mm. long; lemma 1.9-2.0 mm. long, ovate, thin, faintly nerved, 4-toothed at the apex; callus minutely bearded; awn 2.0-3.0 mm. long, straight, inserted at or just below the middle of the lemma; palea a minute nerveless scale, 0.7-1.1 mm. long; anthers 3, purple, 1.2-1.5 mm. long. Chromosome number $n = 21$ from a collection from Poás.

This species is endemic around the crater of Volcán Poás, above 2,500 m. It occurs in meadows, on road embankments, on cinders near the crater, and in openings of the cloud forest. Blooming yearlong.

***Agrostis stolonifera* L., Sp. Pl. 62. 1753, var. *palustris* (Huds.) Farwell, Rep. Michigan Acad. Sci. 21:351. 1919. *A. palustris* Huds., Fl. Angl. 27. 1762.**

Perennial; low, creeping, spreading extensively by slender, elongated stolons, forming a dense leafy mat; branching frequent; stems hollow, glabrous; sheaths glabrous; ligule a thin membrane, up to 8 mm. long; blades 6-20 cm. long, 3-7 mm. wide. Inflorescence solitary, terminal on the trailing stems; panicle slender, contracted, 6-12 cm. long, 1-2 cm. wide, the branches ascending, the rachis usually hidden by the densely clustered short-pedicellate spikelets. Spikelets 2-3 mm. long; first glume ovate, acute, scabrous on the keel; second glume similar but slightly shorter; lemma ca. 1.5 mm. long, ovate, acute, faintly nerved; palea ca. two-thirds as long, anthers 3, ca. 1 mm. long, yellow.

This European grass has been collected in moist pastures of Hacienda Central de Volcán Turrialba, at 2,600 m. elevation. Like *A. gigantea* and *A. tenuis*, which occur in similar habitats, it was probably introduced from Europe in pasture seed mixtures. It produces a lush, soft turf and is much used in temperate climates for golf greens. This group of European species is difficult to interpret, the species being highly variable, with several chromosome numbers and some reported hybridity. The English common name is "creeping bent."

***Agrostis subpatens* Hitchc., N. Amer. Fl. 17:527. 1937. Figure 7.**

Perennial, in dense tufts; plants 20-50 cm. tall; culms erect; internodes 0.5-1.0 mm. thick, hollow, thin-walled, glabrous; culm nodes 2, purple, glabrous; sheaths nearly as long as the internodes, glabrous; ligule a thin white membrane, 3-5 mm. long; foliage mostly basal, the basal blades numerous, erect, tightly folded, ca. 0.6 mm. wide, scabrous beneath, 5-15 cm. long; culm blades wider, 1-2 mm. wide, flat, up to 15 cm. long. Peduncle exserted up to 5 cm.; inflorescence a solitary, terminal, narrowly ovoid, purple panicle, 8-9 cm. long, the length 2-4 × the width; branches clustered, up to 7 per node, spreading at least during anthesis, scabrous, bearing spikelets mostly near the outer ends; pedicels spreading, scabrous, 1-2 × as long as the purple spikelets. First glume 2.9-3.7 mm. long, acute, ovate 6:1 as folded, scabrous on the keel; second glume similar but slightly shorter, 2.5-3.5 mm. long; lemma 1.7-2.2 mm. long, ovate, 4-toothed at the apex; awn inserted below the middle, usually about one-fourth above the base, twisted below, geniculate, exserted near the tips of the glumes; palea absent; anthers 3, purple, 1.0-1.5 mm. long; caryopsis 1.3-1.4 mm. long, narrowly ovate, amber.

Open páramos above 3,000 m. elevation; frequent at Asunción and Buena Vista; Villa Mills; Irazú; Chirripó Grande. Endemic to Costa Rica, the type from Cerro de la Muerte, *Pittier 10470*.

This species is very similar to *A. pittieri* which occurs on Poás. It differs in its more open panicle, lack of a palea, and longer awns. Despite the close resemblance, the single chromosome counts for these species indicate that *A. pittieri* is hexaploid, with $n = 21$, whereas *A. subpatens* is tetraploid with $n = 14$.

***Agrostis tenuis* Sibth., Fl. Oxon. 36. 1794.**

Perennial, 10-70 cm. tall; plants erect or decumbent in some forms, spreading by rhizomes or stolons; culms branching from the base, hollow, glabrous; sheaths glabrous; ligule a short membrane, 0.2-2.0 mm. long, usually less than 1 mm.; leaf blades flat,

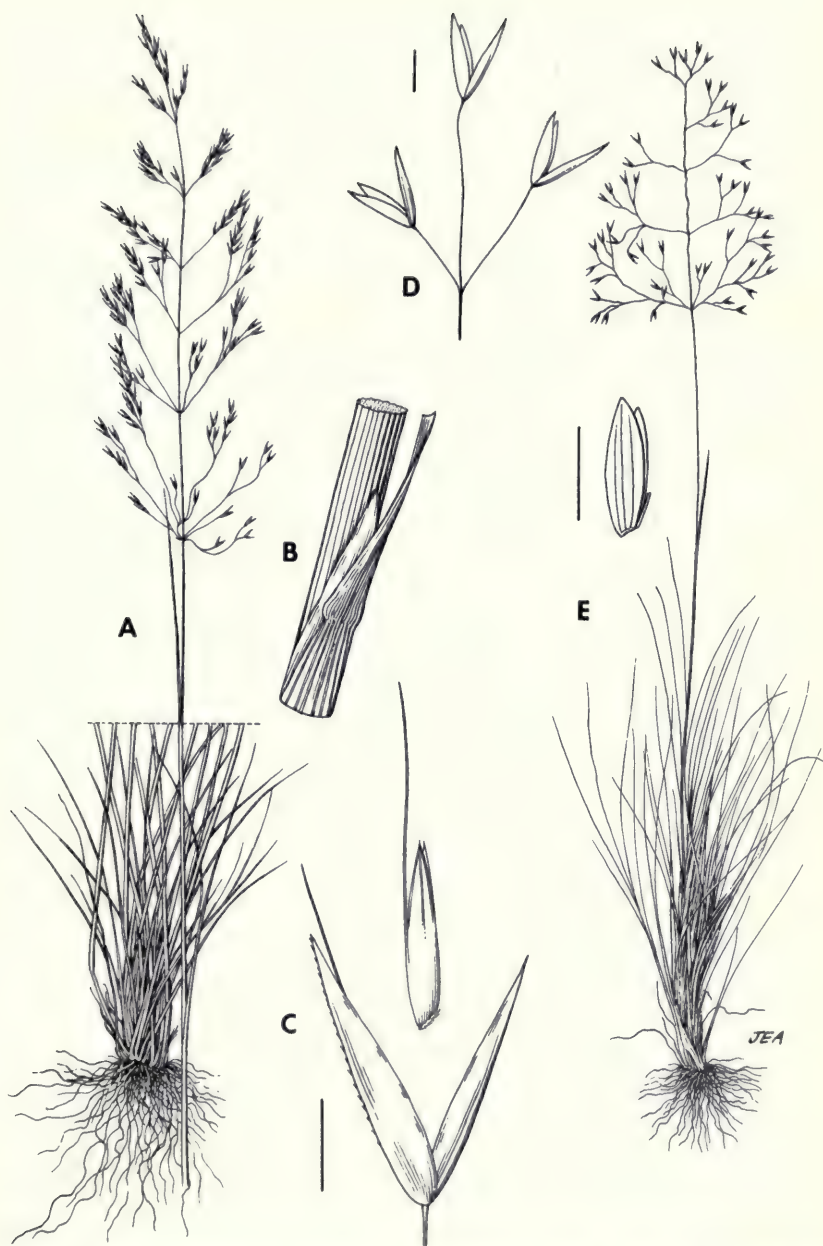


FIG. 7. *Agrostis* species. A. *subpatens*: A, panicle and basal foliage; B, leaf base and ligule; C, spikelet and floret; A. *bacillata*: D, spikelets; E, plant and floret.

glabrous or scaberulous, up to 15 cm. long, 1-5 mm. wide. Peduncle exserted; inflorescence a solitary terminal panicle, ovoid-pyramidal, up to 20 cm. long, open and delicate, the branches naked below; pedicels short. Spikelets 2.0-3.5 mm. long; glumes ovate, acute, the first slightly longer than the second; lemma two-thirds to three-fourths as long as the glumes, ovate, blunt, faintly 3-5-nerved, rarely with an awn; palea one-half or more as long as the lemma; anthers 3, 1.0-1.5 mm. long.

Rare or overlooked, moist pastures on the south slopes of Volcán Turrialba and Volcán Irazú. This species was introduced from Europe, probably as a pasture grass and appears to persist in pastures over 2,000 m. elevation. Certain strains are "bent grasses," forming dense turf by the spreading stolons.

Agrostis tolucensis H.B.K., Nov. Gen. & Sp. 1:135. 1816. *A. hoffmannii* Mez, Repert. Sp. Nov. 18:3. 1922. Figure 6.

Dwarf perennial; plants erect, in dense small tufts; culms slender, ca. 0.5 mm. thick, hollow, glabrous, 8-32 cm. tall; nodes 1-3, purple, the lower internodes shorter; sheaths about as long as the internodes, glabrous; ligule 2.8-4.5 mm. long, a thin white membrane, its margins decurrent onto the sheath; foliage mostly basal, the numerous basal blades 0.7-1.0 mm. wide, tightly folded, 5-10 cm. long, erect, scaberulous; culm blades wider, 1-2 mm. wide, flat, scaberulous on both surfaces, coarsely ridged above, 2-9 cm. long. Peduncle included or exserted up to 8 cm. Inflorescence a solitary spike-like terminal panicle, very narrow and dense, 3-10 cm. long, 3-8 mm. wide, the branches fascicled, erect, short, rarely to 2 cm. long, spikelet-bearing to the base; pedicels erect, mostly scabrous, from very short to about as long as the spikelet; inflorescence purple or lead-colored. First glume 2.3-3.6 mm. long, acute, 1-nerved, ovate 6:1 as folded, scabrous on the keel, usually purple; second glume similar but slightly shorter, 2.1-3.2 mm. long; lemma 2.0-2.8 mm. long, ovate, the apex 4-toothed; awn twisted and geniculate, inserted on the lower third of the lemma, 2.0-2.8 mm. long; palea absent; callus minutely barbed; anthers 3, purple, ca. 1 mm. long. Chromosome number $n = 14$ from a specimen from Irazú.

Páramos, 3,000-3,400 m.; Asunción, Las Vueltas, Villa Mills, Irazú, Turrialba; probably blooming yearlong. Mexico to Chile.

This species, *A. pittieri*, and *A. subpatens* are all very similar in spikelet structure and appear to be closely related. The group merits further study.

Agrostis turrialbae Mez, Rep. Sp. Nov. 18:4. 1922. Figure 6.

Perennial, 10-40 cm. tall; culms erect or the bases decumbent and rooting when growing in very wet sites; culms unbranched or somewhat branched from the base, 0.5-1.0 mm. thick, glabrous, hollow; nodes 1-2, purple, glabrous; foliage mostly from near the base, the terminal internodes much longer than the lower; sheaths glabrous; ligule a thin, white membrane, 1.5-3.5 mm. long; leaf blades thin, flat, 5-10 cm. long, 1-2 mm. wide, the margins scabrid, surfaces glabrous or minutely scaberulous. Inflorescence solitary, terminal; peduncle slender, exserted up to 10 cm.; inflorescence a very open, delicate, elliptical or narrowly pyramidal panicle, 4-12 cm. long, 2-6 cm. wide; branches

fascicled, up to 6 per node, sometimes a few very elongated solitary pedicels with the branches; branches branching once or twice, mostly on the outer half; pedicels longer than the spikelets, diverging strongly from the branches; rachis, branches, and pedicels usually shiny, glabrous or slightly scabrous. Spikelets purplish; first glume ovate, acute, scabrous on the keel, 2.0-2.1 mm. long; second glume similar, 1.8-2.0 mm. long, both apparently 1-nerved; lemma ovate, 1.2-1.4 mm. long, rather blunt, sometimes with a minute abortive awn on the back just below the summit; callus minutely bearded; palea absent; anthers 3, purple, 0.7 mm. long; caryopsis narrowly elliptical, amber. Chromosome number $n = 14$ from *Pinette 1297* from the Cerro de la Muerte.

Moist areas in páramos, mostly above 3,000 m. elevation; Turrialba, Irazú, Las Vueltas, Cerro de la Muerte. February to August. Endemic to Costa Rica.

This species has been identified from material available to me and from the original description and a purported portion of the type in US. The latter specimen, collected by Pittier, unfortunately has lost all of its spikelets, but resembles our specimens in other features. The original description by Mez indicates that the spikelets have long paleas. None of our specimens possesses a palea, but Mez may have been in error in his original observations.

AIRA Linnaeus

Caespitose annual grasses; inflorescence a terminal panicle; spikelets small; laterally compressed; glumes equal, longer than the concealed florets, hyaline, 1-nerved, rounded on the back; florets 2; disarticulation above the glumes and beneath the second floret; lemmas rounded on the back, tapering to 2 acuminate teeth; awns geniculate, twisted below, inserted on the lower part of the backs of the lemmas; rachilla not extended beyond the palea of the second floret.

Aira is a genus of the temperate zone of the Old World, represented in the western hemisphere only by introductions. The genus is related to *Deschampsia* and *Trisetum*. (Pooideae: Aveneae.)

Aira caryophyllea L., Sp. Pl. 66. 1753. Figure 8.

Diminutive caespitose annual; culms 4-15 cm. long, erect or decumbent at the base, branching from the base only, 0.5 mm. thick, hollow, glabrous; nodes glabrous; blades usually 1-2 per culm, borne on the lower half of the culm, 1-2 cm. long, less than 1 mm. wide; ligules pointed, 2-4 mm. long, membranaceous, decurrent on the sheaths; blades mostly withered at flowering time. Peduncle glabrous, slender, elongated, 4-7 cm. long; panicle very open, pyramidal, about as wide as long, 2-3.5 cm. long, with few branches, the spikelets clustered near their tips; pedicels 1-several times as long as the spikelets. Spikelets 2.5-3.0 mm. long; glumes equal or the first slightly longer; florets equal; lemmas lanceolate, brownish, roughened above, 2.1-2.2 mm. long, the nerves obscure; callus minutely bearded; awns once-geniculate, 2.8-3.2 mm. long; the basal segments brown, twisted, the tip exerted from the glumes; anthers 3, 0.3-0.6 mm. long. Chromosome number $n = 14$ from Costa Rican specimens.



FIG. 8. *Aira caryophyllea*. Plant, spikelet, and florets.

This delicate little annual grass has been collected from pastures and the devastated area on Irazú, and also on Turrialba, from 3,000-3,400 m. elevation. June to August. This species is native to Eurasia and Africa. It occurs as an introduction in eastern and western United States, but has not previously been recorded from Mexico or Central America. Probably introduced in seed mixtures.

European authors differ widely in their treatment of this species. Some separate a diploid race ($n = 7$) as true *A. caryophyllea* and regard the tetraploids as a separate species. Böcher & Larsen include both forms as *A. caryophyllea* (in Kongel. Danske Vidensk.-Selsk. Biol. Skr. 10, 2:4. 1958).

ANDROPOGON Linnaeus

REFERENCES: S. T. Blake, Taxonomic and nomenclatural studies in the Gramineae, No. 1, Proc. Roy. Soc. Queensland 80:55-84. 1969. W. D. Clayton, Studies in the Gramineae XXXI. The awned genera of Andropogoneae, Kew Bull. 27:457-474. 1972. F. W. Gould, The grass genus *Andropogon* in the United States, Brittonia 19:70-76. 1967.

Usually perennial and caespitose grasses; inflorescences often complex, but basically composed of units of 2-many rames borne on a bracted or bractless peduncle; rames composed of several to many internodes, these disarticulating at maturity; rachis internodes and pedicels flattened, not thin in the center; each internode bears a sessile, well-developed, fertile, usually awned spikelet at its base; pedicel similar, bearing a reduced, abortive, or obsolete spikelet; internode, pedicel, and spikelet pair shed from the plant as a unit; terminal segment of the rame composed of a sessile spikelet accompanied by two pedicels bearing reduced or abortive spikelets. Sessile spikelets ovate, acute, usually with an exserted geniculate awn; first glume flat or concave between 2 laterally winged submarginal keels, its inflexed edges covering the margins of a boat-shaped, 1-nerved, keeled second glume; glumes subequal, cartilaginous, completely covering and concealing the inner spikelet parts; lower (sterile) lemma hyaline, nerveless, flattened, conforming to the outline of the first glume, lacking a flower or palea; upper (fertile) lemma hyaline, narrow, tapering into an exserted awn, rarely with apical teeth; awn, when present, usually geniculate and twisted just above the base; palea lacking; lodicules oblong, hyaline, vasculated; anthers 1 or 3; style branches 2, separate; caryopsis linear or narrowly ovoid. Pedicellate spikelets much reduced or abortive, mostly lacking flowers, sometimes entirely lacking.

The genus *Andropogon* is variously construed by authors. There is little agreement as to the generic limits. The following genera included in this treatment may by some writers be included in *Andropogon*: *Bothriochloa*, *Cymbopogon*, *Diectomis*, *Euclasta*, *Hyparrhenia*, *Hypogynium*, and *Schizachyrium*. The genus is worldwide in warm temperate and tropical regions. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Andropogon*

- 1a. Spikelets all lacking awns; anthers 3 2
- 1b. Sessile spikelets with conspicuous, exserted awns; anther 1 4
 - 2a. One or several of pedicellate spikelets at tips of each rame enlarged, conspicuous, longer than sessile spikelets; inflorescence a large ovoid compound mass; plants 1-1.5 m. tall *A. bicornis*
 - 2b. Pedicellate spikelets all much reduced or rudimentary; inflorescences 1-several per culm, individually long-stalked; plants less than 1 m. tall 3
- 3a. Leaf blades up to 5 mm. wide, rounded abruptly to a boat-shaped tip; rames 3-5 per peduncle *A. selloanus*
- 3b. Leaf blades 1.5-2.5 mm. wide, tapering to an acuminate tip; rames 2-3 per peduncle *A. leucostachyus*
- 4a. Inflorescence a dense corymbose mass of numerous crowded pedunculate pairs of rames near apex of culm *A. glomeratus*
- 4b. Inflorescence slender and elongated, made up of small groups of axillary peduncles bearing paired rames and arising from sheath axils of upper half of culm *A. virginicus*

***Andropogon bicornis* L., Sp. Pl. 1046. 1753. Figure 9.**

Coarse caespitose perennial, in large, dense clumps; culms erect, up to 2.5 m. tall, branching abundantly from the middle and upper nodes; internodes glabrous, up to 6 mm. thick, hollow, thick-walled; nodes glabrous; basal leaf sheaths densely overlapping, keeled; upper sheaths shorter than the internodes, glabrous; ligule a short, stiff membrane, 1.0-1.2 mm. long, minutely ciliate; leaf blades up to 50 cm. long, 2-6 mm. wide, mostly glabrous or with a few hairs on the upper surface behind the ligule and occasionally with scattered papillose-based hairs on the basal margins; edges and midrib prominently scabrous. Inflorescence a large feathery ovoid compound mass, made up of numerous repeatedly branching axillary branches which terminate in slender wiry peduncles bearing 1-3 slender bladeless sheaths and terminating in a digitate pair (rarely 3) of rames. Rames divergent, 2.5-3.5 cm. long, the rachis and pedicels bearded with hairs up to 8 mm. long; spikelets paired, the pedicellate member of each pair rudimentary or absent, or in the terminal triad, much enlarged and differing from the sessile spikelets; rachis internodes 2.5-3.0 mm. long; pedicels 3.4-4.0 mm. long. Sessile spikelets 3.0-3.5 mm. long, ovate, acute; first glume flattened, with 2 lateral keels, nerveless between the keels; margins inflexed, clasping the edges of a boat-shaped, 1-nerved second glume 2.3-2.7 mm. long; lower (sterile) lemma 2.0-2.4 mm. long, conforming in shape to the first glume, hyaline, nerveless, its upper margins ciliate; upper (fertile) lemma 1.6-2.2 mm. long, hyaline, nerveless; anthers 3, 0.5-0.7 mm. long, purple; caryopsis cylindrical, brown, 1.6-2.0 mm. long. One pedicellate spikelet of the terminal triad and occasionally 1 to several of the lower ones enlarged, conspicuous, 3.7-4.1 mm. long, somewhat laterally compressed, first glume convex on the back, 5-nerved; second glume boat-shaped, 3-nerved, 3.5-3.7 mm. long; sterile lemma 3.0-3.5 mm. long; fertile lemma 2.8-3.0 mm. long; flower lacking or staminate, the 3 anthers 0.5-1.0 mm. long. Chromosome number $n = 30$ from Costa Rican specimens.

This species is a common weedy inhabitant of open roadsides and savannas or brushy areas, on both Pacific and Caribbean slopes, from low elevations to 1,500 m. The plants are conspicuous because of their



FIG. 9. *Andropogon* species. A. *bicornis*: A, portion of a rami showing enlarged terminal spikelet; B, plant base and compound inflorescence; A. *glomeratus*: C, portion of rami with awned spikelets.

large, plummy inflorescences. Flowering mostly from July to October, but more or less intact inflorescences may be found at other times of the year. Southern Mexico to Bolivia and Argentina; West Indies. Common names: *Cola de Venado*, *Cola de Coyote*.

Andropogon glomeratus (Walt.) B.S.P., Prelim. Cat. N.Y. 67. 1888. *Cinna glomerata* Walt., Fl. Carol. 59. 1788. *Andropogon virginicus* L., var. *abbreviatus* (Hack.) Fern. & Griseb., Rhodora 37:142. 1935. Figure 9.

Densely caespitose perennial; culms erect, 60-150 cm. tall, branching freely from the middle and upper nodes; internodes up to 6 mm. thick, solid, pithy, glabrous; nodes glabrous; basal sheaths strongly keeled, closely overlapping; much of the foliage basal; margins of the sheaths appressed-hirsute, the back usually glabrous; ligule a stiff ciliate membrane, 0.8-1.5 mm. long; leaf blades up to 60 cm. long, 4-7 mm. wide, the tip acute, boat-shaped; midrib keeled beneath, scabrous; margins sometimes with a few long hairs near the base. Inflorescence a large ovoid feathery mass, the numerous upper branches repeatedly branching, terminating in bracted peduncles, each bearing a pair (rarely 3) of divergent rames, each 2-3 cm. long; rachis internodes and pedicels strongly ciliate with silky hairs 5-8 mm. long; internodes 2.0-3.2 mm. long, the pedicels 3.5-4.2 mm. long. Sessile spikelets 3.2-3.5 mm. long, ovate 6:1, acute; first glume flat, with 2 marginal ciliate scabrous keels, the edges inflexed over the margins of the second glume; second glume 3.0-3.2 mm. long, 1-nerved, boat-shaped, keeled; lower (sterile) lemma hyaline, 2.3-2.7 mm. long, conforming to the shape of the first glume; upper (fertile) lemma hyaline, 1-nerved, 2.0-2.5 mm. long, narrow, tapering to an awn 10-15 mm. long; base of the awn weakly twisted and geniculate near the base; anther 1, 0.8-1.3 mm. long, brownish; lodicules 2, oblong, hyaline, vasculated; carpopsis linear, up to 1.8 mm. long, brown. Pedicellate spikelets abortive, linear, 1-2 mm. long.

Open roadsides, marshes, pastures, occasional in the Meseta Central; San Vito; elevations from 1,100-1,800 m.; beach at Limón. July to November, rarely later. Southeastern and southern United States; Yucatan and Central America; West Indies.

This species is superficially similar to *A. bicornis*, but the plants are smaller, and the spikelets are awned. It also differs from *A. bicornis* in stamen number, the latter having three anthers.

Andropogon leucostachyus H.B.K., Nov. Gen. & Sp. 1:187. 1816.

Caespitose perennial in dense tufts; plants 40-100 cm. tall, culms erect, branching on the upper half; internodes 0.7-2.0 mm. thick, solid, pithy, glabrous; nodes glabrous; foliage mostly basal; sheaths keeled, glabrous; ligule membranaceous, 0.7-1.7 mm. long; leaf blades up to 32 cm. long, 1.5-2.5 mm. wide, keeled beneath, tapering to an acuminate apex; upper surface with a few weak hairs above the ligule. Peduncles slender, wiry, several exerted from each of the upper 3 or more leaf sheaths, each bearing a bladeless sheath; each peduncle bears a terminal inflorescence of 2-3 slightly divergent silky rames, 2-4 cm. long, the tan to purplish spikelets mostly concealed by the white to beige hairs; rachis internodes flattened, 1.8-2.7 mm. long, the apex obliquely cup-

shaped; hairs up to 9 mm. long, the longest ones near the summit; pedicels similar but thinner, 2.5-3.5 mm. long. Sessile spikelets 2.7-3.2 mm. long, ovate 5-6:1, acute; callus bearded with silky hairs 4-5 mm. long; first glume 2.6-3.2 mm. long, 2-keeled; its marginal flanges inflexed and clasping the margins of the second glume; second glume 2.3-2.7 mm. long, boat-shaped, 1-nerved, the keel convex; lower (sterile) lemma hyaline, conforming in shape to the first glume, 1.8-2.6 mm. long, its upper margins ciliate, tip tapering into a slender weak included awn; upper (fertile) lemma hyaline, keeled, 1.5-2.5 mm. long, ciliate on the upper margins; palea absent or a short, nerveless scale; anthers 0.6-0.7 mm. long, yellow; caryopsis 1.8-2.3 mm. long, fusiform, amber; pedicellate spikelet abortive, 1.1-1.5 mm. long. Chromosome number $n = 10$ from Costa Rican specimens.

Dry savannas at elevations up to 740 m.; La Cruz, Nuestro Amo, Buenos Aires, Paso Real, Boruca, Cabagra, Cañas Gordas. April to December. Southern Mexico to Argentina; West Indies.

Andropogon selloanus (Hack.) Hack., Bull. Herb. Boissier II. 4:266. 1904. *Andropogon leucostachyus* ssp. *selloanus* Hack. in DC., Monogr. Phan. 6:420. 1889.

Perennial, caespitose in small, dense clumps; culms 40-110 cm. tall, branching from the middle and upper nodes, erect; internodes to 3.5 mm. thick, solid, pithy, glabrous; nodes glabrous, slightly shrunken; foliage mostly basal, the upper leaf blades more or less reduced; sheaths shorter than the internodes, strongly compressed and keeled, glabrous; ligule a short-ciliate membrane, 0.5-1.0 mm. long; leaf blades up to 40 cm. long and 5 mm. wide, ciliate near the base with scattered elongated, weak, papillose-based hairs; blade tip concave, boat-shaped, blunt. Peduncles several from each of the upper 2-3 sheaths, slender, bearing bladeless sheaths. Individual inflorescences of 3-5 rames borne subdigitately at the bearded apex of the peduncle; rames forming a fan-shaped group, ascending, 3-6 cm. long; rames very silky, whitish or beige; rachis internodes 2.0-2.8 mm. long, flattened, the apex obliquely cup-shaped, the edges bearded, the hairs up to 10 mm. long, the longest ones near the summit of the internode; pedicels similar but thinner, 3.5-3.8 mm. long. Sessile spikelets 3.2-3.5 mm. long, bearded on the callus with hairs up to 6 mm. long; spikelet acute, ovate ca. 5:1, the glumes glabrous; first glume concave between the 2 marginal keels, slightly winged below the bifid tip, its marginal flanges clasping the edges of the second glume; second glume equal to the first, boat-shaped, 1-nerved, the keel convex; lower (sterile) lemma 2.0-2.5 mm. long, flattened, conforming to the shape of the first glume, hyaline, nerveless, empty; upper (fertile) lemma hyaline, keeled, conforming to the second glume, narrowly triangular, nerveless, 1.5-2.0 mm. long, tapering to an acuminate apex or a weak short awn, the upper margins ciliate; palea absent or a small nerveless ciliate scale; anthers ca. 0.6 mm. long, white; stigmas emerging laterally from the glumes; caryopsis linear, ca. 1.7 mm. long. Pedicellate spikelet rudimentary, 0.6-1.2 mm. long, inconspicuous.

This species is apparently rare in Costa Rica. Our only specimen is the following: Guanacaste, 4 km. S of LaCruz along the CIA, 230 m., rocky roadside in open savanna, 27 June 1968, *Pohl & Davidse 10590B*. Southern Mexico, Guatemala, Belize, Honduras, Costa Rica, and Panama to Argentina; West Indies.

***Andropogon virginicus* L., Sp. Pl. 1046. 1753.**

Caespitose perennial in dense tufts; plants 50-100 cm. tall; culms erect, branching freely from the middle and upper nodes; internodes compressed, to 4 mm. thick, hollow but partially pithy, glabrous; basal sheaths closely overlapping, strongly keeled, hirsute on the margins; foliage mostly basal; ligule a ciliolate membrane, 0.5-0.7 mm. long; leaf blades up to 35 cm. long, the basal ones longest, 2-5 mm. wide, hirsute near the base and on lower margins, strongly keeled beneath; branches several from each of the middle and upper nodes, slender and wiry, erect or ascending, each bearing several peduncles that arise in the axils of bladeless spathes; peduncles very short, less than 1 cm. long, each bearing at its apex 2-4 digitate, diverging rames 2-3 cm. long; subtending spathes mostly as long as the rames; rachis internodes and pedicels ciliate with abundant silky hairs, these up to 8 mm. long; rachis internodes 1.5-3 mm. long; pedicels 3.1-5 mm. long. Sessile spikelets narrowly ovate 4-5:1, acute, 3.8-4.1 mm. long; first glume flattened, the 2 lateral keels scabrous-ciliate near the apex, the margins inflexed and covering the edges of the second glume. Second glume 3.5-3.6 mm. long, boat-shaped, keeled, 1-nerved; lower (sterile) lemma hyaline, 3.0-3.5 mm. long, conforming in shape to the first glume; upper (fertile) lemma hyaline, narrow, 2.5-3.0 mm. long, ciliate; awn 11-17 mm. long, twisted near the base; anther 1, 0.8 mm. long, purple; caryopsis ovate 4-5:1, 1.9-2.4 mm. long, brown. Pedicellate spikelets rudimentary or absent.

This is a common, highly variable species in the eastern and mid-western United States, extending southward to Panama and the West Indies. It is rare in Costa Rica, being known only by the following specimen: San José, Guadalupe, *Hitchcock 8483*, 22-24 October 1911.

Andropogon virginicus is a member of an intricate complex of species or subspecific populations that intergrade freely. The common member of this group in Central America is *A. glomeratus*, which differs in its much denser and more compact inflorescence.

ANTHEPHORA Schreber

REFERENCE: J. P. Reeder, The systematic position of the grass genus *Antheophora*, Trans. Amer. Microscop. Soc. 79:211-218. 1960.

Caespitose annual grasses; inflorescence a cylindrical spike of fascicled spikelets; fascicles overlapping, attached singly at the nodes of a tortuous rachis and readily detachable from it; fascicle with a short, thick basal stipe which bears 4 thick, rigid, many-nerved ovate bracts, these enclosing 2-4 spikelets, 1 or 2 of them sterile or reduced to small rudiments; first glume absent, second glume acicular, awned, 1-nerved; sterile lemma, fertile lemma and its palea subequal, as long as the spikelet; sterile lemma 7-nerved; fertile lemma faintly 3-nerved; caryopsis plump, elliptical, with a large embryo.

Some authors interpret the bracts of the fascicle as first glumes of the spikelets. (Panicoideae: Paniceae.)

***Antheophora hermaphrodita* (L.) O. Kuntze, Rev. Gen. Pl. 2:759. 1891. *Tripsacum hermaphroditum* L., Syst. Nat. ed. 10. 2:1261. 1759. Figure 10.**

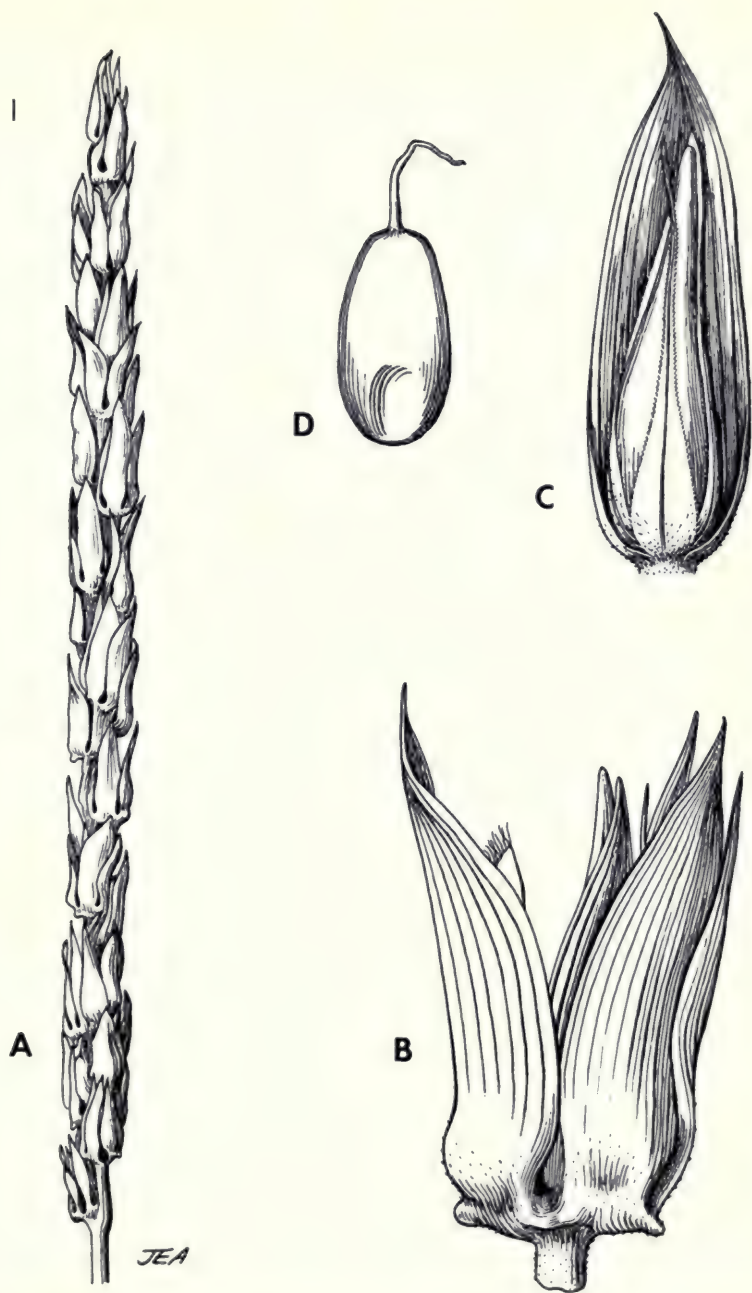


FIG. 10. *Anthephora hermaphrodita*. A, inflorescence; B, detached fascicle; C, spikelet inside of external bract; D, caryopsis.

Caespitose annual; culms erect or sometimes decumbent and rooting at the lower nodes, branching from the base; culms glabrous, hollow, the nodes not prominent; prophylla up to 17 mm. long; leaves numerous, the sheaths mostly overlapping; sheaths and blades papillose-hispid to nearly glabrous; ligule a brownish membrane, 1.5-2.5 mm. long; blades flat, 4-17 cm. long, 2-8 mm. wide; peduncle included or exerted up to 10 cm.; inflorescence solitary, terminal, slender, cylindrical, 4-12 cm. long, 5-8 mm. in diameter, bearing up to 60 fascicles; fascicles 5-7 mm. long, the bracts ovate, acuminate, flat and somewhat recurved near the tips; fertile spikelets 3.5-4.5 mm. long, ovate, acute; first glume absent; second glume acicular, awn-tipped, 1.7-4.2 mm. long; sterile lemma 3.6-4.5 mm. long, 7-nerved, scabrid between the nerves; fertile lemma 3.7-4.0 mm. long, glabrous, faintly 3-nerved, its thin margins overlapping the edges of the palea; caryopsis plump, elliptical, ca. 2 mm. long. Chromosome number $n = 9$ from Costa Rican material.

Sea beaches and lowland pastures and disturbed areas, especially common along the Pacific Coast. June to December, probably year-long. Mexico to Peru and Brazil; Caribbean Islands.

ANTHOXANTHUM Linnaeus

Caespitose grasses; inflorescence a dense, spikelike terminal panicle; spikelets laterally compressed; glumes unequal, the first 1-nerved, much shorter than the 3-nerved second, which exceeds the florets and envelopes them; disarticulation above the glumes; florets 3, falling as a group; lower 2 florets sterile, lacking paleas; lemmas 5-nerved, obtuse and bifid at the tip; first floret with a straight awn from the back above the middle; second floret with a longer twisted geniculate awn from near the base; third (fertile) floret awnless, blunt, the lemma 1-nerved, slightly bifid; palea 1-nerved, longer than the lemma; anthers 2; flower perfect. Plants with odor of coumarin. (Pooideae: Phalarideae.)

***Anthoxanthum odoratum* L., Sp. Pl. 28. 1753. Figure 11.**

Slender perennial, forming small tufts; culms erect or spreading, 30-60 cm. long, ca. 1 mm. thick, hollow, glabrous; nodes dark, somewhat contracted, glabrous; leaves few; sheaths shorter than the internodes, glabrous or with weak retrorse hairs, ciliate at the throat; blades 5-20 cm. long, 2-7 mm. wide, glabrous or with scattered weak, soft hairs, conspicuously auriculate, the dewlap often purplish. Peduncle slender, smooth, 10-35 cm. long; panicle solitary, terminal, dense, 4-8 cm. long, cylindrical, the rachis covered by the imbricated spikelets; branches very short, the spikelets subsessile; spikelets lanceolate in outline, 6.5-9 mm. long; glumes membranaceous, glabrous or with scattered weak hairs, the first ovate, acute, 3.5-4 mm. long, 1-nerved, the second ovate, acuminate, 3-nerved, 6.5-8.5 mm. long; sterile florets subequal, 2.5-3.2 mm. long, the lemmas oblong, dilated near the tip, brownish and appressed-hirsute on the lower parts, whitish, glabrous, translucent near the tip; fertile floret 2.0-2.5 mm. long, the lemma glabrous, broadly ovate; flower protogynous, the stigmas and anthers extruding apically; lodicules absent or not functioning; anthers pink or purplish, 4-5 mm. long. Chromosome number $n = 10$ from Costa Rican material.

Common along roads and in moist pastures; upper elevations of



FIG. 11. *Anthozanthum odoratum*. A, plant and inflorescence; B, awned sterile floret; C, awnless fertile floret; D, spikelet.

Poás, Barba, Irazú, Turrialba; blooming from June to November, possibly yearlong. This Eurasian grass was introduced into North America to give a sweet odor to hay. It occurs from Greenland and British Columbia southward through the moister parts of the United States. In Costa Rica, its occurrence in dairy pastures suggests that it was introduced as a component of early seed importations.

This species is generally regarded as an undesirable weed, since it contains the bitter toxic substance coumarin, which is also responsible for the sweet, vanilla-like odor.

ARISTIDA Linnaeus

REFERENCES: J. Th. Henrard, A critical revision of the genus *Aristida*, Meded. Rijks-Herb. 54:VIII + 747. 1926, 1927, 1928, 1933; A monograph of the genus *Aristida*, Meded. Rijks-Herb. 58:1-325 + 159 plates + XII. 1929, 1932. A. S. Hitchcock, The North American species of *Aristida*, Contr. U.S. Natl. Herb. 22:7:517-586. 1924.

Annual or perennial, nearly always caespitose grasses of low to moderate stature, often of xeromorphic aspect; culms unbranched or less commonly branched; internodes slender, solid or thick-walled; sheaths usually somewhat keeled; ligule a minute ciliate rim; blades flat or usually folded or involute. Inflorescence a terminal panicle, open or congested. Spikelets 1-flowered, disarticulating above the glumes; glumes keeled, subequal or unequal, usually 1-nerved, at least the first scabrous on the keel, the apices often bifid and with a short straight awn-tip; floret about as long as the glumes, or the column exceeding them; lemma rigid, cylindrical, its margins overlapping; callus oblique, sharp-pointed, often prominent, bearded with ascending hairs; apex of the lemma often prolonged into a straight or twisted beak or column, this often scabrous; awns 3, or by abortion of the lateral ones, single; central awn usually longer than the lateral ones, sometimes bent or curved; lateral awns similar to the central one or much shorter in some species; all awns in our species upwardly scabrous; palea small, completely concealed by the lemma, or not evident; lodicules 2 or 3; anthers 3, or by abortion, 1; caryopsis linear-cylindric.

Aristida is a large genus of grasses distributed in temperate and tropical climates throughout the world. They are most abundant in grassland, savanna, and desert climates. Most of the species are low in the plant successional stages, and become very abundant upon disturbance or overgrazing of grasslands. They have little forage value, and are disliked because of their offensive florets. The combination of a sharp, bearded callus, rigid lemma, and upwardly scabrous awns enables the florets to penetrate clothing, fur, or hair, or to irritate eyes, nostrils, and mouth. Henrard indicates that the genus contains about 320 species. In spikelet structure, the genus resembles *Stipa*, but is not regarded as being closely related. Species such as *A. ternipes* and

A. jorullensis, with reduced lateral awns, may be confused with species of *Muhlenbergia*. (Arundinoideae: Aristideae.)

KEY TO SPECIES OF *Aristida*

- 1a. Central awn well-developed, lateral awns rudimentary (up to 3 mm. long), or absent 2
- 1b. All 3 awns well-developed, laterals at least half as long as central awn 3
 - 2a. Lateral awns present but short; plants lacking scattered long weak hairs; panicles large and very open, up to 50 cm. long; spikelets borne near the tips of branches *A. ternipes*
 - 2b. Lateral awns absent; foliage and inflorescences bearing elongate weak hairs; panicle slender, up to 20 cm. long *A. jorullensis*
- 3a. Panicles open, elliptical or pyramidal, rachis plainly exposed throughout the length 4
- 3b. Panicles narrow, usually congested, axis more or less concealed by the branches and spikelets 5
 - 4a. Lemmas less than 3 mm. long; delicate low annual, usually less than 35 cm. tall, lacking curled basal leaves *A. capillacea*
 - 4b. Lemmas 10-12 mm. long; perennial, up to 1 m. tall; basal leaf blades persistent, conspicuous, curly *A. laxa*
- 5a. All 3 awns loosely contorted above the base into loose ascending spiral; basal leaf blades conspicuous, persistent, curly *A. recurvata*
- 5b. Awns not spirally contorted, central awn sometimes strongly recurved; plants lacking curly basal foliage 6
 - 6a. Lemma 8-9 mm. long, the upper 2.0-2.5 mm. twisted, scabrous; first glume scabrous only on the keel; foliage bearing elongated weak hairs *A. orizabensis*
 - 6b. Lemma less than 5.5 mm. long, the upper portion straight, not twisted; first glume scabrous on the keel and surface; foliage lacking elongated weak hairs *A. tincta*

***Aristida capillacea* Lam., Tabl. Encycl. 1:156. 1791. Figure 12.**

Delicate tufted annual, in small dense clumps; plants 5-37 cm. tall; culms very slender, ca. 0.5 mm. thick, the internodes angular, reddish-speckled, glabrous, solid, branching from the base and usually from a middle node; leaves ca. 4 per culm, 2 from the base and 2 from 2 adjacent middle nodes that are separated by a very short internode; sheaths glabrous; ligule a minute ciliolate rim, ca. 0.2 mm. long; leaf blades 0.5-0.7 mm. wide, folded; lower surface glabrous; upper surface ridged, scabrous, bearing scattered elongate weak hairs that emerge between the folded edges of the blades. Peduncle elongated, making up, with the panicle, ca. two-thirds of the height of the plant; inflorescences terminal, often a second axillary one borne from a middle node of the culm; panicle open, delicate, ovoid 3:1, 3-10 cm. long; branches usually paired, up to 3 cm. long, bearing spikelets on their outer half; rachis and branches angular, scabrous; pedicels slender, flexuous, longer than the spikelets. Spikelets V-shaped, the glumes spreading; glumes subulate, scabrous on the keel and with scattered scabrous hairs on the surfaces, often purplish; first glume 2.2-3.0 mm. long, 1-nerved, scabrous on the keel, tapering to an awn tip; second glume similar, 2.5-3.5 mm. long, faintly 3-nerved; lemma linear-cylindric, 1.8-2.2 mm. long, including the blunt, bearded callus, scabrous near the apex;

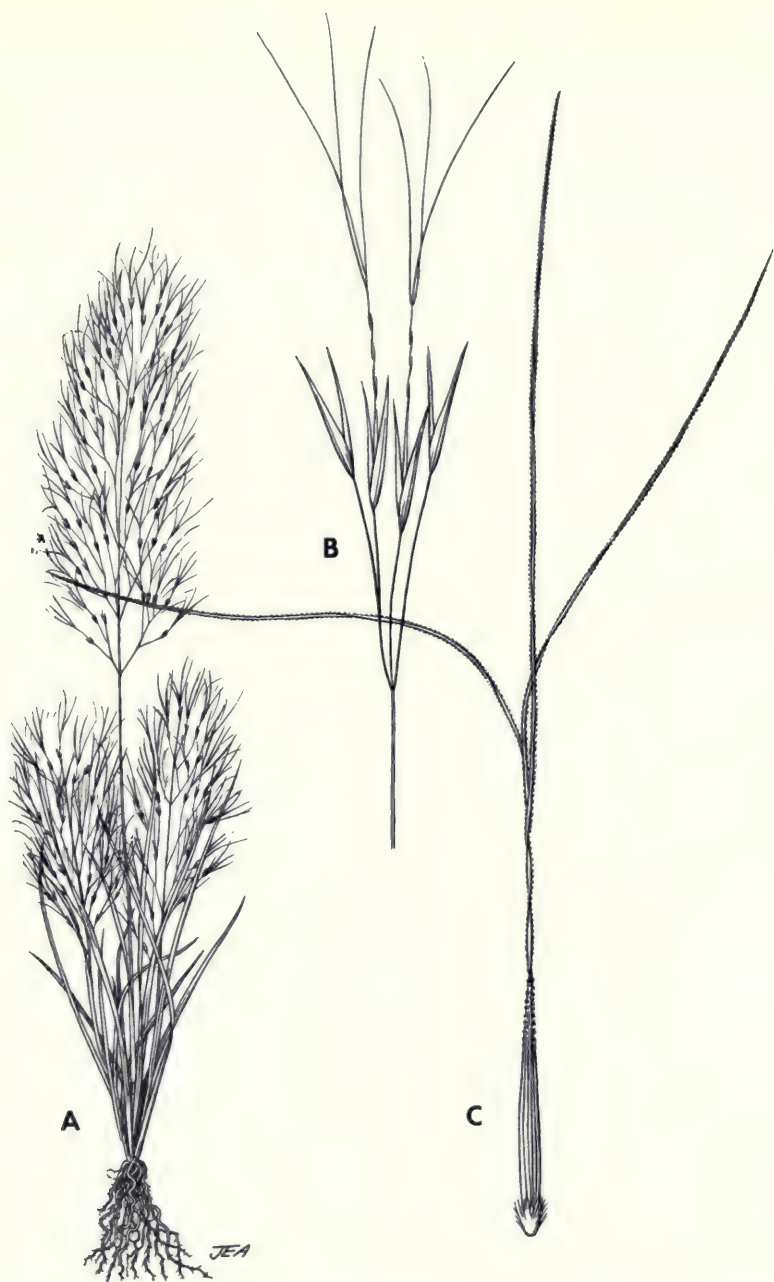


FIG. 12. *Aristida capillacea*. A, plant with panicles; B, group of spikelets; C, single floret.

column twisted, 1.5-2.2 mm. long; awns 3, slightly contorted, the central one 4.5-7.5 mm. long, the lateral ones slightly shorter; palea not seen; anthers 3, purple, 0.3 mm. long; caryopsis linear-cylindric, 1.4 mm. long, amber, translucent. Chromosome number $n = 11$ from a Costa Rican specimen.

The delicate little plants of this species occur on dry, open sites, mostly at low elevations and never over 1,000 m. They are especially common on volcanic tuff savannas in Guanacaste and have also been collected in the General Valley at Boruca, Buenos Aires, and Paso Real; Hacienda Argentina; San Ramón. December to February. Southern Mexico to northern South America, Brazil and Bolivia.

***Aristida jorullensis* Kunth, Rev. Gram. 1:62. 1829. Figure 13.**

Caespitose annual, in dense, small tufts; culms 10-60 cm. tall; branching abundant from 1-3 culm nodes; internodes very slender, solid, glabrous; nodes glabrous; leaf sheaths glabrous; ligule a minute ciliate rim, 0.1-0.2 mm. long; leaf blades 4-20 cm. long, 1.0-1.5 mm. wide, folded or involute; upper surface uniformly finely ridged, scaberulous, with scattered elongated flexuous hairs that gyrate when wetted. Inflorescences terminal on the main culm or on leafy branches; peduncle slender, weak, up to 15 cm. long; panicle slender, 6-20 cm. long; rachis exposed between the isolated solitary branches; branches 1-4 cm. long, bearing appressed spikelets to their bases; rachis, branches, and glumes bearing elongated weak flexuous hairs. Spikelets V-shaped, the glumes diverging, subequal; first glume subulate, 1-3-nerved, scabrous on the keel, 4.5-9.0 (rarely 19) mm. long; second glume similar, 5.0-8.5 (rarely 13) mm. long; floret 4-7 cm. long, without clear distinction of lemma and awn; callus ca. 0.5 mm. long, bearded with hairs ca. 1 mm. long; lemma somewhat laterally compressed, scabrous above in lines, linear, tapering gradually into a flattened scabrous beak and flexuous awn; lateral awns absent; palea 1.0-1.5 mm. long; anthers 3, 1.1-1.7 mm. long, purple. Chromosome number $n = 11$ from a Costa Rican specimen.

This species occurs on dry *Curatella-Byrsonima* savannas on volcanic tuff in northern Guanacaste, from sea level to 200 m. elevation, and in *Crescentia* savannas. It has also been collected at Turricares and Rodeo de Pacaca. Blooming mostly from September to January, occasionally in June and July. Pacific Coastal regions, from Central Mexico to Panama.

This species is somewhat anomalous in the genus *Aristida* because of its lack of lateral awns. The general structure of the spikelets, however, indicates that it is closely related to *A. ternipes*, in which the lateral awns are very short.

***Aristida laxa* Cavanilles, Icon. et Descr. Pl. 5:44. 1799. *A. spadicea* H.B.K., Nov. Gen. & Sp. Pl. 1:123. 1816.**

Caespitose perennial in small dense tufts; plants up to 1 m. tall; culms unbranched; internodes 1.0-1.5 mm. thick, glabrous, solid; nodes glabrous, not prominent; sheaths



FIG. 13. *Aristida* species. A. *ternipes*: A, panicle; B, single floret; A. *jorullensis*: C, spikelet and single floret; D, portion of a panicle.

glabrous, slightly keeled; ligule ca. 0.5 mm. long, a short ciliate crown; leaf blades 15-30 cm. long, up to 2.5 mm. wide, flat near the base, involute above; lower surface glabrous; upper surface ridged, scaberulous, with scattered weak thin hairs near the base and throat; basal blades becoming twisted with age. Peduncle elongated, slender; inflorescence an open, solitary, terminal, pyramidal panicle; rachis and branches angular, scaberulous; branches ascending, straight, solitary but branched into 2 just above the base, up to 8 cm. long; spikelets borne on the outer half of the branch, appressed, short-pedicellate. Glumes subequal, the first 9.5-11.8 mm. long, subulate 6:1, scabrous on the keel and the surfaces; second glume similar but glabrous, 10-12 mm. long; lemma linear-cylindrical, 10-12 mm. long; callus short, 0.5 mm. long, bearded with hairs up to 1.5 mm. long; body of lemma often mottled with dark coloration, glabrous below, scabrous above, passing into a scabrous, twisted beak or column, 5-9 mm. long; central awn strongly curved at the base, straight above, 24-30 mm. long, the lateral awns shorter, somewhat spreading; anthers 3, ca. 1.6 mm. long, dark.

Known from Costa Rica only by the following specimen: Guanacaste, Liberia, hilly *Curatella-Byrsonima* savanna on volcanic tuff, 14 January 1969, P. & D. 11653. Mexico to Ecuador.

Aristida orizabensis Fourn., Mex. Pl. 2:78. 1881. *A. pseudospadicea* Hubb., in Proc. Amer. Acad. Arts 49:500. 1913. *A. orizabensis*, var. *pseudospadicea* (Hubb.) Henrard, Meded. Rijks-Herb. 54:473. 1928. *A. arizonica*, sensu Hitchc., Contr. U.S. Natl. Herb. 22:7: 568. 1924, non Vasey.

Caespitose perennial in dense tufts; plants erect; culms unbranched or sparingly branched, 15-85 cm. tall, ca. 1 mm. thick, hollow, glabrous; sheaths usually longer than the internodes, glabrous; ligule a minute ciliate rim, 0.2-0.3 mm. long; leaf blades usually 15-30 cm. long, 1.5-2.0 mm. wide, glabrous beneath, flat near the base and folded or involute above; upper surface with flat, thickened marginal bands of sclerenchyma, the central parts finely ridged, scaberulous; throat and basal parts of upper leaf surface with scattered elongated weak hairs that gyrate when wetted; leaf tip tapering to a long attenuate point. Inflorescence a solitary terminal panicle, 8-17 cm. long, ca. 2 cm. wide, narrow, interrupted, the solitary branches ascending, branched immediately above the base and spikelet-bearing to the base, angular and scabrous. Spikelets appressed to the branches, V-shaped, the glumes spreading; first glume 6.5-8.0 mm. long, including the short awn tip, triangular 6:1, scabrous on the keel; second glume similar, slightly longer, 7.0-8.0 mm. long, not scabrous; lemma linear-cylindric, dark mottled, 7.8-9.0 mm. long, including the bearded callus 0.5-1.0 mm. long and slightly twisted, scabrous column 2.0-2.5 mm. long; awns divergent, the central one longer than the lateral ones and more curved at the base, 10-25 mm. long, the lateral ones slightly shorter; anthers 3, purple or yellow, 1.7-1.9 mm. long. Chromosome number $n = 22$ from a Costa Rican specimen.

Dry savannas, northern Guanacaste, at elevations up to 400 m.; Boruca. Blooming June to December. Principal season of bloom appears to be from June to August. Southern Mexico to Panama.

The plants are quite variable. Early season collections are generally shorter, whereas those collected in the dry season are tall.

***Aristida recurvata* H.B.K., Nov. Gen. & Sp. 1:123. 1816.**

Tufted perennial, in dense clumps; culms usually 50-70 cm. tall, erect, unbranched; internodes ca. 1 mm. thick, hollow, glabrous; basal foliage abundant and persistent, the blades flat, 2-3 mm. wide, up to 30 cm. long, thick, with broad, flat marginal bands of sclerenchyma; middle of upper surface finely ridged and scaberulous, bearing scattered elongate weak hairs; blades becoming spirally curled; upper blades involute, ca. 1 mm. wide; sheaths longer than the internodes, glabrous; ligule a minute ciliolate rim, less than 0.2 mm. long. Peduncle slender, glabrous, 10-23 cm. long; inflorescence a solitary terminal panicle, 5-30 cm. long, narrowly cylindrical, less than 2 cm. wide, dense; branches numerous, ascending, overlapping, mostly 1-3 cm. long, many-flowered; spikelets crowded on the branches, their pedicels erect, 1-3 mm. long. Spikelets 8.5-12.5 mm. long, excluding the awns, slender; first glume linear, tapering to a short awn, 1-nerved, 8.5-12.5 mm. long, the keel scabrous; second glume similar but slightly shorter, 8.0-10.5 mm. long, 1-nerved, not scabrous; floret linear, the short callus bearded; lemma glabrous below but scabrous in lines on the upper portion, 3.5-4.0 mm. long, tapering into a scabrous, twisted beak ca. 2 mm. long; awns loosely spirally contorted on the lower part, 12-16 mm. long, the central awn slightly longer than the 2 lateral awns; anthers 3, 1.4 mm. long, orange, connivent around the style branches.

Uncommon or overlooked; dry *Curatella-Byrsonima* savannas on volcanic tuff, 200 m. elevation; Hacienda Las Animas; Liberia. December and January. Belize, Costa Rica, Panama, Venezuela to Brazil.

***Aristida ternipes* Cavanilles, Icon. et Descr. Pl. 5:46. 1799. Figure 13.**

Perennial, caespitose in large tufts, 80-150 cm. tall, the culms ascending to erect, unbranched, 1.5-4.0 mm. thick, glabrous, solid; nodes not prominent, glabrous; sheaths mostly overlapping, glabrous; ligule a stiff ciliolate rim, ca. 0.2 mm. long; leaf blades flat near the base and involute above, passing into an elongated attenuate scabrous tip; length up to 50 cm.; width 3-5 mm.; upper surface with appressed hispid hairs near the base; surface marked with alternating wide flat white bands of sclerenchyma and sets of several very narrow green scaberulous ridges. Inflorescence a solitary terminal open panicle, making up, with the exerted peduncle, half or more of the total height of the plant; length up to 50 cm.; shape open pyramidal; branches solitary but branched immediately above the base, appearing binate or ternate; rachis angular and scabrous above; branches slender, wiry, scabrous, bearing short-pedicellate spikelets only on the outer half and appressed to the branchlets. Spikelets linear, the glumes subulate, not strongly diverging; first glume 6.5-11.5 mm. long, faintly 3-nerved, tapering to a short awn, scabrous on the keel; second glume similar, 8-12 mm. long; lemma subulate, cylindrical, glabrous, 15-22.5 mm. long to the point of insertion of the awns; callus 0.5-1.0 mm. long, bearded with hairs 2-3 mm. long; central awn stiff, arched, 10-15 mm. long; lateral awns erect, obsolete or up to 3 mm. long; palea stiff, up to 1.3 mm. long; anthers 3, ca. 2.7 mm. long, tan; caryopsis linear-cylindric, 7.0-8.5 mm. long, amber.

Dry savannas, northern Guanacaste, Nicoya Peninsula; Atenas; Río Catarata; sea level to 600 m. elevation. Blooming principally from late October to December. Rare bloom may occur on old culms at the

beginning of the rainy season. Southwestern United States to Colombia and Venezuela; Caribbean Islands.

This species is not readily recognized as belonging to *Aristida* because the minute lateral awns can be overlooked. *Aristida jorullensis* has similar spikelets, but is much smaller.

Aristida tinctoria Trin. & Rupr., Gramina Agrostidea III. Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., (Seconde Pt. Sci. Nat. 5:111. 1849.) *A. breviglumis* Mez, Repert. Sp. Nov. (Fedde) 17:152. 1921.

Perennial; densely caespitose in small hard tufts; plants erect, 25-85 cm. tall; culms unbranched, 0.5-1.3 mm. thick, hollow but thick-walled, glabrous; sheaths longer than the internodes, glabrous; ligule a minute rim, ca. 0.2 mm. long; auricles sometimes with a few slender hairs; leaf blades stiff, ascending, flat or folded, up to 25 cm. long and 2.5 mm. wide, glabrous beneath, ridged and scabrous above, the margins with thick bands of sclerenchyma. Inflorescences solitary, terminal; peduncle exerted up to 20 cm.; panicle narrowly cylindrical, 10-18 cm. long, rather dense; branches solitary, erect, 1-4 cm. long, densely flowered to their bases. Glumes subequal, the first scabrous on the keel and surface, 4.5-6.7 mm. long, subulate; second glume similar but glabrous, 4.5-5.8 mm. long; lemma 4.2-5.3 mm. long, including the very short, nearly glabrous callus, linear-cylindric, without a twisted column, coarsely scabrous toward the apex; central awn recurved, ca. 15 mm. long, the lateral awns ascending, 8-11 mm. long; anthers 3, 1.2 mm. long.

Aristida tinctoria occurs on the savannas of Buenos Aires, elevation 250 m. It was collected by Tonduz in 1891 and 1892. The latter (*Tonduz 4879*) is the type number of *A. breviglumis* Mez. Collections made in 1943 by Jorgé León and in 1966 by Alfonso Jimenez are from the same area. Blooming in February and March. This species is primarily South American, ranging from Brazil and the Guyanas to Venezuela, Panama, and Costa Rica.

The name of this species was published in November 1849, although the title page indicates that the work was exhibited in a meeting in June 1842. The title, usually misstated, is Gramina Agrostidea, III., Callus obconicus (Stipacea).

ARTHRAOXON Beauvois

Delicate creeping annual; inflorescences numerous, borne on slender terminal and axillary peduncles, fan-shaped, each composed of 2-several slender digitate spikes; spikelets sessile, solitary at each node of a slender disarticulating rachis, falling accompanied by the rachis internode, sometimes with a minute abortive pedicel also attached at the base of the spikelet; spikelets laterally compressed; glumes subequal, completely concealing the inner bracts of the spikelet; first glume 5-nerved, membranaceous, folded

asymmetrically, keeled; second glume 3-nerved, keeled; sterile lemma a minute nerveless scale; fertile lemma narrow, thin and hyaline, bearing a twisted brown awn near its base, the awn exerted from the tip of the spikelet; palea lacking. (Panicoideae: Andropogoneae.)

Arthraxon quartinianus (A. Rich.) Nash, N. Amer. Fl. 17:2:99. 1912. *Alectoria quartiniana* A. Rich., Tent. Fl. Abyss. 2:448. 1852. Figure 14.

Culms sprawling, rooting at the lower nodes, 10-75 cm. long; branching profuse, the plants making spreading patches; prophylla brown, membranaceous, 10-20 mm. long; culms slender, hollow, glabrous; nodes bearded with spreading pubescence; sheaths much shorter than the internodes, ciliate along the margin, sometimes sparsely hirsute on the back; ligule a ciliate membrane, 1.0-1.5 mm. long; blades lanceolate, cordate-based, 2-6 cm. long, 3-11 mm. wide, ciliate on the margins, more or less papillose-hirsute on both surfaces; peduncles thin, flexuous, up to 10 cm. long; inflorescences 1.5-5 cm. long, fan-shaped, purplish, the rachis internodes silky-ciliate; spikelets sessile, oblong-lanceolate, 3.0-3.5 mm. long, usually purplish, scabrous on the nerves near the apex; awn geniculate, exerted 3-5 mm; anthers purple, 0.5-0.6 mm. long. Chromosome number $n = 18$ from Costa Rican material.

Occasional along roads and in moist seepy open areas, mostly in or near the Meseta Central. In Costa Rica, this species appears to flower from October to December. In Honduras, however, we have collected it in June and July. Southern Mexico, Guatemala, Honduras, Central Costa Rica. Introduced from the Old World.

ARTHROSTYLIDIUM Ruprecht

REFERENCE: F. A. McClure, Genera of bamboos native to the New World, Smithsonian Contr. Bot. 9:15-21. 1973.

Plants caespitose; culms and branches not thorny; culms cylindrical, hollow, erect or clambering and drooping; midculm nodes with a single branch bud, covered with a pair of flattened bracts; branch subtended by a bulge on the main culm below the branch attachment; branches few-numerous in a fan-shaped cluster from the midculm and upper nodes; one branch (the primary one) usually larger than the others; leaf blades lacking pronounced commissural veins. Inflorescences determinate racemes, lacking bracts. Spikelets sessile or nearly so; glumes 1 or 2, the third bract a sterile lemma; perfect-flowered florets several, the rachilla terminating in a sterile reduced floret; lemma and palea gaping; lodicules 3, one smaller than the other two; anthers 3; stigmas 2. (Bambusoideae: Arthrostylideae.)

KEY TO SPECIES OF *Arthrostylidium*

- 1a. Erect or pendent plants, culms up to 2 cm. thick and 10-15 m. long; sheaths and internodes strongly hispid with appressed hairs. *A. pubescens*
- 1b. Plants sprawling or trailing; culms 3 mm. or less thick, up to 3 m. long; culms and sheaths not hispid *A. venezuelae*

Arthrostylidium pubescens Ruprecht, Bambuseae Monogr. Ex-



FIG. 14. *Arthraxon quartinianus*. A, portion of a spike, the spikelets accompanied by rudimentary pedicels; B, inflorescence.

ponit 29. 1839. *Arundinaria pubescens* (Rupr.) Hack., Oesterr. Bot. Z. 53:69. 1903. Figure 15.

Caespitose bamboos, the culms 10-50 per clump, 10-15 m. long, at first erect, later arching and leaning, the upper ends long trailing and forming curtains of foliage; internodes cylindrical, hollow, up to 2 cm. in diameter, green, densely hispid-scabrous with appressed glassy papillose-based hairs, their lumens filled with blackish material; sheaths tight, appressed-hispid as the internodes; blades of midculm sheaths erect, as wide as the sheath apex, up to 23 cm. long, appressed-hispid. Hairs of culm internodes and sheaths irritating, readily penetrating human skin; ligules of culm sheaths ca. 2 mm. long, thick and stiff, erose, bearing stiff brown branching trichomes up to 5 mm. long on their outer surface. Foliage-bearing branches numerous, up to ca. 40 per node, one longer and thicker than the others; internodes and sheaths of branchlets mostly glabrous, the sheath margins ciliate; auricles densely fringed with stiff erect branching brown bristles up to 9 mm. long; pseudopetioles flattened, 2-3 mm. long; leaf blades ovate 7-10:1, acute or acuminate, drooping, slightly glaucous, glabrous except for a few fine hairs on the lower surface near the base; margins scabrous.

Forested slopes at elevations below 1,200 m., rare. We have collected this species twice in Costa Rica, these collections apparently being the first North American records. Although both colonies were vegetative, the specimens are a good match for South American material so named by McClure in the U.S. National Herbarium. The colony along Hwy. 232 between Bajo de Pacuare and Grano de Oro occupies an extensive area on a south-facing hillside below the road. The culms clamber into trees and their upper portions form dense drooping curtains of foliage. Our collections are: Prov. Cartago, 7 km. by road E of Río Pacuare, elevation 900 m., 6 June 1976, *Pohl & Pinette 13183*; Moravia de Chirripó, 1,100-1,200 m., 9 August 1968, *Pohl & Davidse 10875*.

Arthrostylidium venezuelae (Steud.) McClure, J. Wash. Acad. Sci. 32:172. 1942. *Chusquea venezuelae* Steud., Syn. Pl. Glum. 1:337. 1854. *Arundinaria standleyi* Hitchc., Proc. Biol. Soc. Wash. 40:79. 1927.

Slender weak bamboo, the culms 1-3 mm. thick, the lower internodes solid, the upper hollow, glabrous or retrorsely appressed-pubescent, scaberulous toward the apex; branches few per node; nodes glabrous or sparsely retrorse-pubescent; sheaths mostly glabrous, ciliate on the overlapping margin toward the apex; sheath auricles truncate, bearing numerous flexuous brown bristles, up to 9 mm. long; ligule a minute ciliate rim ca. 0.2 mm. long; pseudopetioles flattened, puberulent above, 1.0-3.5 mm. long; leaf blades flat, dark green, ovate 5-8:1, acuminate, 5-14 cm. long, 10-15 mm. wide, glabrous above, bearing scattered weak hairs beneath. Inflorescence of short racemes borne on leafy branches, 5-8 cm. long; rachis strongly flexuous; internodes 1.0-1.5 cm. long; spikelets subsessile, diverging strongly from the rachis. Spikelets 1-2 cm. long, very narrow; florets 4-8; first glume 3-4 mm. long, 5-nerved; second glume 4-5 mm. long, 7-nerved; lemmas appressed-pilose, 9-nerved, 6.0-7.5 mm. long, tapering to an obtuse, awnless apex; palea subequal, ciliate on the keels near the tip; rachilla internodes at least three-fourths as long as the lemma, flat below, tapering to a strongly thickened

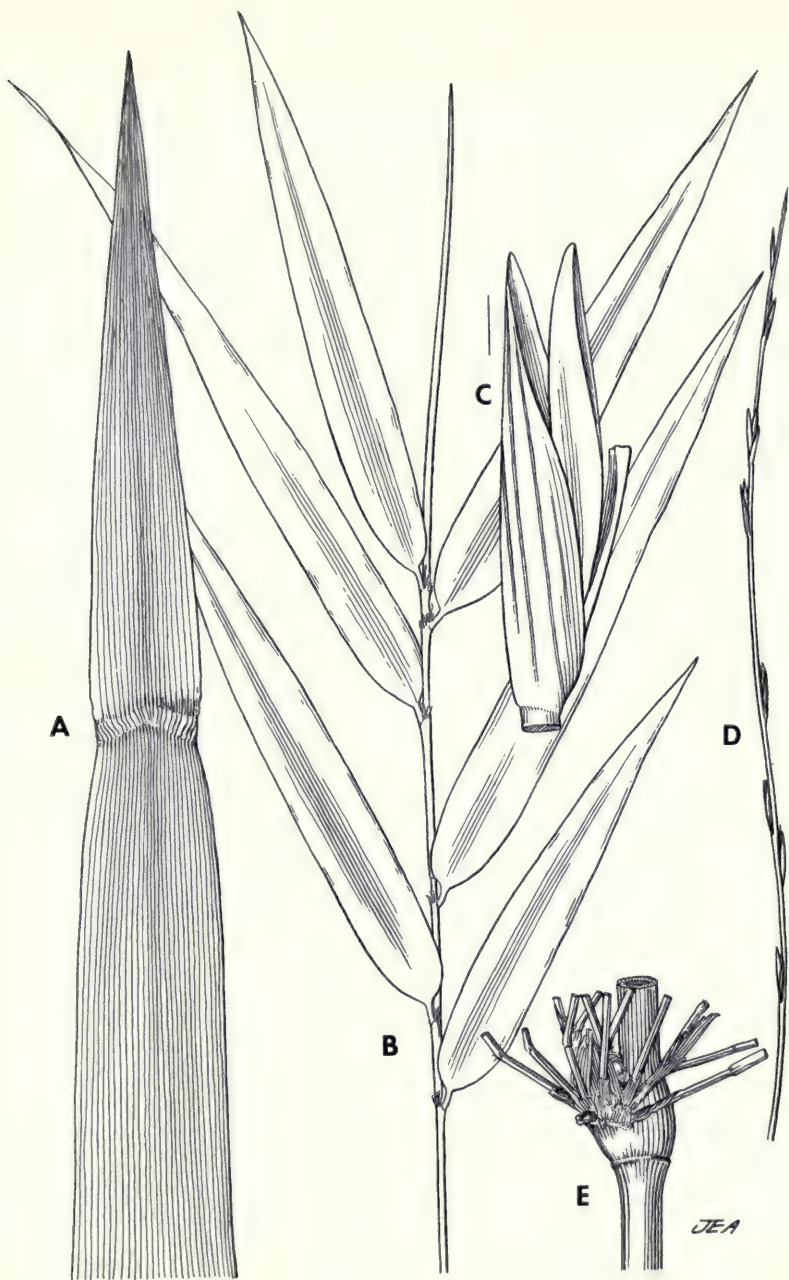


FIG. 15. *Arthrostylidium pubescens*. A, culm sheath with erect blade; B, foliage-bearing branch; C, a floret; D, a branch with spikelets; E, foliage-bearing branches arising from a bulge above the node.

cupulate apex, glabrous except for minute cilia at the apex; anthers 3, yellow, 3.2-3.5 mm. long.

This species was originally collected in Costa Rica from the vicinity of El Muñeco. The only flowering specimens are the type of *Arundinaria standleyi*, Standley & Torres 51060 and another specimen from the same area, Standley & Torres 50897. One recent collection (Pohl & Davidse 11787) from this area is vegetative. It occurred in dense moist forests south of El Muñeco. Our most recent collection (Pohl & Pinette 13303) occurred in wet forests 3.6 km. by road NE of the Tapantí Bridge. The species here occurred as a large colony, the plants vinelike and ascending into trees to ca. 8 m., forming dense curtains of foliage. The slender culms arose from dense, knotty crowns. Lower portions of the culms were solid, but upper internodes had a small lumen.

ARUNDINELLA Raddi

REFERENCES: H. J. Conert, *Beiträge zur Monographie der Arundinelleae*, Bot. Jahrb. 77:226-354. 1957. C. E. Hubbard, The genera of the Tribe Arundinelleae, Bull. Misc. Inform. 317-322. 1936.

Perennial, mostly caespitose grasses; inflorescence a terminal panicle; spikelets usually paired, on pedicels of differing lengths; spikelets laterally compressed, 2-flowered, usually V-shaped and wide open; glumes unequal, narrow, acute or acuminate, the first 3-nerved, slightly shorter than the first floret, the second 3-5-nerved, much longer than the florets; disarticulation at the base of the second floret; lower floret sterile or staminate, its lemma acute, awnless, membranaceous, 3- or weakly 5-nerved; second floret much shorter than the first, perfect-flowered, its lemma acuminate, long-awned from the tip or between 2 minute teeth, weakly nerved, the margins inrolled over the margins of the palea, the callus bearded, awn geniculate, exserted; rachilla not prolonged beyond the floret. (Panicoideae: Arundinelleae.)

KEY TO SPECIES OF *Arundinella*

- 1a. Awn 4-6 mm. long, the lower segment tightly twisted *A. confinis*
- 1b. Awn 8-13 mm. long, the lower segment straight or only loosely twisted 2
- 2a. Leaf blades 3-6 mm. wide; culms 1.5-2.0 mm. thick, usually less than 1 m. long
..... *A. berteroniana*
- 2b. Leaf blades 8-25 mm. wide; culms 3-7 mm. thick, 1-4 m. long .. *A. deppeana*

Arundinella berteroniana (Schult.) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:290. 1917. *Trichochloa berteroniana* Schult., Mant. 2:209. 1824.

Perennial, in small, dense clumps, tightly clinging to rocks or timbers; culms 75-115 cm. long, erect to arching, rarely becoming decumbent and rooting from the lower nodes, usually unbranched, 1.5-2 mm. thick, hollow, glabrous; nodes appressed-pubescent; sheaths mostly overlapping, more or less appressed papillose-hispid; ligule 0.5 mm. long, a thickish membrane; blades up to 25-35 cm. long, 3-6 mm. wide, flat, more or less

papillose-hispid above and beneath; auricular hairs prominent; midrib prominent; margins with a thick stramineous band, scabrous. Panicle solitary, terminal, slender, 20-40 cm. long, 4-6 × longer than wide; branches slender, virgate, mostly simple, 10-15 cm. long. Spikelets mostly paired, V-shaped, the glumes recurved, conspicuously nerved; first glume lanceolate 3.2-4.5 mm. long, 3-nerved, the nerves scabrous; second glume lanceolate, tapering to a narrow but often truncate apex, smooth, 4.2-5.5 mm. long; lower floret sterile, the lemma lanceolate, acute, usually 3-nerved or rarely weakly 4- or 5-nerved near the apex, glabrous, palea 1.5-2 mm. long; upper floret disarticulating above the first floret, perfect-flowered; lemma 1.5-1.8 mm. long, narrowly lanceolate, faintly 3-nerved, scabrid, brownish when mature, the margins inrolled over the edges of the palea; palea 1.3-1.5 mm. long; awn once geniculate, the lower segment not strongly twisted; anthers 3, purple, 0.6-0.7 mm. long. Chromosome number $n = 10$ from Costa Rican material.

Conert states that this species is rhizomatous. While rooting culms are found, these were usually knocked down by flowing water, and are not true rhizomes. The plants occur along streams, usually anchoring very tightly on rocks or dead logs. This species occurs occasionally along rocky streams on both the Caribbean and Pacific slopes, at elevations from 60-1,400 m. Blooming is apparently yearlong. Mexico to Brazil; West Indies.

Arundinella confinis (Schult.) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:290. 1917. *Piptatherum confine* Schult., Mant. 2:184. 1824. Figure 16.

Stout caespitose perennial; culms 95-185 cm. tall, erect, unbranched; culm 4-5 mm. thick, hollow, glabrous; nodes appressed pubescent; leaf sheaths mostly overlapping, glabrous near the base, hispid near the apex; ligule a minute thickish membrane, 0.2-0.3 mm. long; leaf blades 20-25 cm. long, 9-16 mm. wide, more or less papillose-hispid above, especially just above the ligule, or on both sides. Peduncle hollow, glabrous, 2-4 mm. thick, exserted 20-45 cm.; panicle solitary, terminal, cylindrical, dense, about 25 cm. long, 4-6 × longer than wide; branches densely whorled; floriferous to the base. Spikelets usually paired, rather densely arranged on the branches, laterally compressed, 3.7-4.2 mm. long; first glume 2.2-2.9 mm. long, lanceolate, 3-nerved, the nerves ridged, scabrous; second glume 3.7-4.2 mm. long, 3-5-nerved, lanceolate, tapering to a slender truncate apex; lower floret sterile, its lemma 2.1-1.5 mm. long, glabrous, narrowly ovate, acute, 3-nerved, the nerves faint, palea 1.8-2 mm. long; fertile floret lanceolate, 1.5-2 mm. long, bearded on the callus; awn 4-6 mm. long, geniculate, the lower segment brown, tightly twisted when mature; palea 1.3-1.6 mm. long; anthers 3, 0.8-0.9 mm. long, purple.

Rare; savannas near El Paraíso, Boruca, and Cañas Gordas at elevations from 400-1,200 m. November to December. Mexico to Panama; West Indies.

Arundinella deppeana Nees, Bonplandia 3:84. 1855. Figure 16.

Perennial from knotty crowns, with many basal innovations; culms 1-4 m. tall, erect to arching or scrambling through brush, unbranched, 3-7 mm. thick, hollow, thick-walled,



FIG. 16. *Arundinella* species. *A. deppeana*: A, panicle; B, spikelets and fertile floret; *A. confinis*: C, spikelets; D, fertile florets.

glabrous; nodes appressed-pubescent; sheaths overlapping, ciliate on the margin, appressed-papillose hispid, especially near the apex; ligule a minute ciliate membrane, 0.2-0.3 mm. long; larger blades 25-50 cm. long, 8-25 mm. wide, more or less appressed-hispid on both sides, strongly so on the upper surface just above the ligule. Peduncle glabrous, 4-30 cm. long; panicle solitary, terminal, loosely cylindrical, 20-60 cm. long. 4-5 × longer than wide. Spikelets usually paired and unequally pedicellate, often purplish, laterally compressed, 3.8-4.8 mm. long; first glume 2.8-3.2 mm. long, 3-nerved, lance-attenuate; second glume 3.8-4.8 mm. long, 5-nerved, lance-attenuate; lower floret 2.3-2.5 mm. long, sterile; lemma lanceolate, acute, 3-nerved, glabrous, acute; the palea 1.5 mm. long; second floret disarticulating above the first floret, perfect-flowered; lemma ca. 1.5 mm. long, lanceolate, faintly 3-nerved, bearded at the base; tapering to a minutely bifid apex; awn flat, only slightly twisted, geniculate, 10-13 mm. long; palea 1-1.3 mm. long; anthers 3, 0.7-1 mm. long, purple; mature fertile lemma scabrid, brownish, its margins inrolled over the edges of the palea. Chromosome number $n = 10$ from Costa Rican plants.

Occasional, savannas, forest margins, brush, road embankments; Pacific slope, 300-1,700 m. elevation, from northern Guanacaste to Panama. Blooming yearlong. Mexico to Brazil; West Indies.

Common name: *Cola de venado*. The panicles are sometimes sold for ornament.

ARUNDO Linnaeus

Giant perennial reeds, the culms arising from thick scaly rhizomes and forming large colonies; inflorescence a large plummy terminal panicle. Spikelets laterally compressed, plumose, V-shaped; glumes about equal, 3-5-nerved, nearly as long as the entire spikelet; florets 4-5, their tips all about at the same level; rachilla disarticulating above the glumes and between the florets; lemmas with 3 principal vascular bundles and 2-4 weak secondary ones, densely long-hairy on the lower portions of the back, minutely awned between 2 hyaline teeth; tip of the glabrous rachilla bearing a reduced abortive floret.

Species three, in Formosa, Asia, and the Mediterranean lands; one species naturalized in warm temperate and tropical parts of the Americas. The genus is related to *Cortaderia* and *Gynerium*, and, like them, has plummy spikelets. (Arundinoideae: Arundineae.)

Arundo donax L., Sp. Pl. 81. 1753. Figure 17.

Culms arising from thick, scaly rhizomes; plants up to 8 m. tall, culms erect or arching, simple or extravaginally branched above; nodes glabrous, mostly concealed; internodes hollow, up to 4 cm. thick; foliage distributed rather uniformly along the culm except in old stems, strongly distichous; sheaths longer than the internodes and strongly overlapping, glabrous; leaf blades up to 1 m. or more long, up to 6 cm. wide, glabrous, the margins scabrous; leaf bases broader than the sheaths, with prominent triangular brownish flanges ciliate on the margins; ligule a thin whitish or brownish minutely ciliate membrane, 1.0-1.5 mm. long. Inflorescence borne on a cylindrical glabrous hollow peduncle up to 1.5 cm. thick; panicle up to 60 cm. long, ovoid, dense, the branches

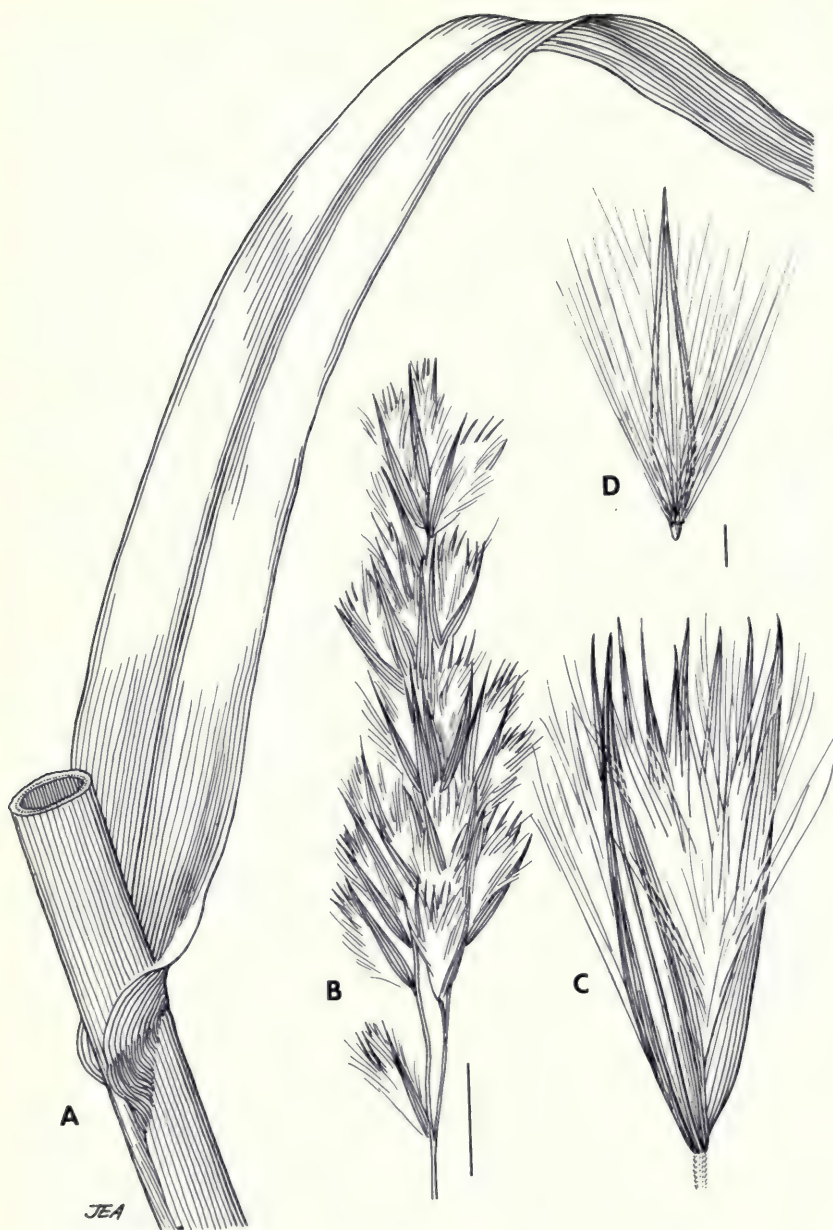


FIG. 17. *Arundo donax*. A, culm internode and leaf; B, branch of panicle with spikelets; C, single spikelet; D, one floret.

ascending. Spikelets densely clustered along secondary or tertiary branches, 10-14 mm. long; glumes hyaline, brownish or purplish, 11-13 mm. long, acuminate; florets 4-5, the upper ones progressively shorter than the lower, so that the tips are about at the same level; lemmas 8-12 mm. long, lance-ovate, tapering into a short straight awn which arises between 2 delicate lateral teeth; nerves 3-7, usually 3 major ones anastomosing with the midrib; lower portions of the back of the lemma heavily bearded with long, silky whitish hairs, up to 8 mm. long; palea up to 5 mm. long, about half as long as its lemma, whitish, membranaceous, scabrid on the keels and pubescent near the base between them, hyaline, truncate; callus short, rounded, short-hairy at its upper end; rachilla glabrous; flower with 2 truncate lodicules; stamens 3, the anthers 2.5-3.0 mm. long, yellow; pistil with 2 apical elongated style branches, terminating in plumose cylindrical brownish stigmas.

Cultivated in the Meseta Central for ornament, and escaping to roadsides and river banks; practically never blooming under Costa Rican conditions.

Most of the cultivated plants of this species in Costa Rica are the form with leaves longitudinally yellow-striped. This has been called var. *versicolor* (Mill.) Stokes. Our only flowering specimens of this species are of the striped form, and were growing in San José. It seems probable that the plants will bloom under Costa Rican conditions only where supplied with artificial illumination to extend the day length. Some escaped stands are of the wild type with green leaf blades. Common name: *carrizo*.

AULONEMIA Goudot

REFERENCE: F. A. McClure, Genera of bamboos native to the New World, Smithsonian Contr. Bot. 9. *Aulonemia*, pp. 53-61. 1973.

Caespitose bamboos of small stature, forming small clumps; culms succulent, arising from scaly short, thick (pachymorph) rhizomes; culms leafy above the middle, erect or scrambling in vegetation; midculm branches mostly solitary and about as large as the main culm and strongly divergent from it, the subtending leaf sheath gaping; sheaths often bearing conspicuous oral setae; leaf blades broad, lanceolate or ovate; inflorescence an open panicle. Spikelets few- to many-flowered, the uppermost floret reduced and sterile; disarticulation above the glumes; first glume small, acute, 3-nerved; second glume obtuse, 7-nerved; lowermost floret sometimes sterile; lemmas 7-9-nerved, mucronate or awned; paleas 2-keeled; lodicules 3, unequal; stamens 3; stigmas 2.

Aulonemia is a tropical American genus of 24 species. The largest number of species occurs in Brazil, with others from Guyana to Ecuador. Three species occur in Central America and Mexico. (Bambusoideae: Arthrostylidiaceae.)

KEY TO SPECIES OF *Aulonemia*

- 1a. Leaf blades broadly ovate, 2.7-3.5 × longer than wide; auricular bristles numerous, up to 30 mm. long *A. patriae*

- 1b. Leaf blades narrowly ovate, 4.7-6.0 × longer than wide; auricular bristles absent
A. viscosa

Aulonemia patriae* Pohl, *sp. nov.

Gramen altum, sublignosum, perenne, monocarpicum, ab *A. laxa* (Maekawa) McClure spiculis muticis, gluma inferiore longiore (5-7 mm. vs. 2 mm.), lemmate primo fertili, palea lemmatum fertilium lemmatibus aequante, et ab *A. viscosa* (Hitchc.) McClure spiculis longioribus (2.5-4.0 cm. vs. 1.5-2.5 cm.), gluma prima longiore (5-7 mm. vs. 2-5 mm.), laminis foliorum latoribus, orificio vaginarum setiferarum recedit.

Perennial, in small clumps of up to 10 culms; culms erect below, to 5 m. long, the lower internodes up to 1 m. long, less than 1 cm. thick, naked or with reduced leaf blades; culms branching from the middle and upper nodes; branches one per node, diverging from the main stem at angles of 30-45 deg., pushing the leaf sheath away from the main stem; upper stem portions scrambling through brush; internodes glabrous, hollow, soft and succulent, easily crushed, strongly viscid just below the nodes; a short, thick obconical internode, ca. 5-6 mm. long present just above the insertion of each leaf sheath, the prophyllum and branch attached at the summit; leaf sheaths glabrous, often purple-spotted, viscid at the apex; pseudopetioles flattened, viscid, 5-6 mm. long; sheath apex truncate, bearing numerous flattened flexuous bristles up to 30 mm. long; external ligule a short, stiff membrane; internal ligule a stiff ciliate membrane 1.2-2 mm. long; leaf blades spreading or drooping, flat, glabrous except for the scabrous margins; tip rather abruptly acuminate; blades 20-26 cm. long, 4-8 cm. wide, ovate 2.7-3.5:1, the base rounded and asymmetric; undersurface glaucous; prophylla ca. 5 cm. long, with 2 strong keels, many-nerved, the smaller nerves occurring both between the keels and on the marginal flanges. Peduncles terminal, exserted to 25 cm.; panicles ca. 40 cm. long; branches ascending, solitary, to 34 cm. long, their branches strongly divaricate, solitary; pedicels solitary, stiff, divaricate, 20-40 mm. long; spikelets relatively few. Spikelets 2.5-4.0 cm. long, 3-5 mm. wide, linear; first glume ovate 3:1, 5-7 mm. long, 7-nerved; second glume 7 mm. long, ovate 3:2, 11-nerved; florets ca. 5; disarticulation above the glumes and between the florets; lemmas 13-17 mm. long, awnless, 9-11-nerved, ovate 3:1, acute, scaberulous on the back; palea as long as the lemma, strongly 2-keeled, the keels ciliate; lateral flanges broad, enveloping the flower; tip bidentate; rachilla internodes 6-8.5 mm. long; lodicules 3, brown or purple, obovate, the upper two-thirds of the margins ciliate; anthers ca. 9 mm. long; styles separate; caryopsis cylindric, 8-10 mm. long, crowned with the persistent style bases; terminal floret rudimentary, cylindric, ca. 9 mm. long.

Aulonemia patriae is similar to *A. viscosa* of the Talamanca Range and *A. laxa* of Mexico. With the recent discovery of fruiting material of all three species, it has been possible to differentiate them. Their principal differential characters are given below.

	Auricular bristles	Palea/ lemma length	Awn length (mm.)	Spikelet length (cm.)	First glume		Sterile lemmas
					L (mm.)	Nerves	
<i>A. laxa</i>	+	0.3-0.7	7-10	5.5-7.0	2	1	1
<i>A. patriae</i>	+	equal	0	2.5-4.0	5-7	7	0
<i>A. viscosa</i>	0	equal	0	1.5-2.5	2-5	3-5	0

This species occurs in a scattered stand on steep, wet canyon walls of the pass at Alto del Roble, just south of the new bridge over the Rio Patria (Rio Las Vueltas). The colony consists of possibly several hundred individuals, most of them very inaccessible on the steep walls, with a few other plants growing on steep embankments north of the Rio Patria. I have observed the colony repeatedly since 1968, and saw no signs of flowering until 1978. The stems are very soft and succulent for a bamboo, and the nodes, upper portions of the sheaths, pseudopetioles, and bases of the leaf blades are prominently viscid. Flowering occurred prior to June, 1978, when the colony was revisited. At this time, the entire colony had flowered, and the plants were moribund. Most of the spikelets had disarticulated, and many of the stems were disarticulating at the nodes. This species presumably has been more widespread in the past, since it also occurs on the Cordillera de Talamanca. Because the appearance of the vegetative and flowering plants is so radically different, I am designating specimens of both phases from the type locality as syntypes.

SYNTYPES: Costa Rica: Prov. Heredia: Alto del Roble, N of Heredia, in the pass, just S of the new bridge; elev. 2,000 m., entire colony, on both vertical walls of canyon E of road, fruiting and dead or dying; old culms disarticulating. *Pohl & Gabel 13577*. 12 June 1978 (fruiting); Same locality and colony: *Pohl 12798*. 8 April 1972 (vegetative). Syntypes in ISC.

Other collections: Costa Rica: Prov. Heredia: Alto del Roble. *Pohl & Davidse 11781*, 30 March 1969; Prov. Cartago: Madre Selva, km. 67, along CIA; elevation 2,500 m. *Pohl & Davidse 10751*. 25 July 1968.

Aulonemia viscosa (Hitchc.) McClure, Smithsonian Contr. Bot. 9:61. 1973. *Arundinaria viscosa* Hitchc., Proc. Biol. Soc. Wash. 40:79. 1927. Figure 18.

Caespitose perennial bamboo, the culms solitary or in small clumps from pachymorph rhizomes, 4-5 m. tall, 5-15 mm. thick, hollow, glabrous, erect or scrambling, forking, the solitary branch at each middle node nearly as thick as the main culm and strongly divaricate from it; surface of culms strongly purple spotted or solid purple; nodes conspicuous, very viscid in living plants; sheaths shorter than the internodes, glabrous, striate, conspicuously purple spotted; apex of sheath with an erect rounded auricle on one side; internal ligule a firm membrane, 1.0-2.5 mm. long; external ligule (exterior to the insertion of the pseudopetiole) 0.5-1.0 mm. long, thick; pseudopetiole 5-7 mm. long, viscid; leaf blades few, flat, ovate 4.7-6:1, acuminate, 21-26 cm. long, 4-5 cm. wide, the bases rounded and oblique; glabrous and dark green above, scaberulous and glaucous beneath. Peduncle purple splotched, viscid, as also the rachis and branches of the panicle; inflorescence apparently terminal, an open pyramidal panicle, 15-25 cm. long; branches solitary, naked at the base; spikelets solitary, on elongated stiff flexuous



FIG. 18. *Aulonemia viscosa*. A, panicle; B, spikelet with sterile terminal floret; C, culm internode with a single leaf.

pedicels. Spikelets laterally compressed, linear, 1.5-2.5 cm. long, disarticulating above the glumes and between the 3-6 florets; glumes 2, the first 3-5 mm. long, lanceolate, acute, 3-nerved; second glume 7-9 mm. long, narrowly ovate, blunt-tipped, 7-nerved; lemmas narrowly ovate, blunt-tipped, 13-14 mm. long, 7-nerved, internally purple spotted; palea equal to the lemma, scabrous on the keels; caryopsis ovoid 4:1, tapering to an acuminate apex, dark brown.

Cerros de Velirla near Copey (TYPE: *Tonduz 11729*); between División and Lagunilla; Chirripó Grande. Rare, moist forests between 1,800-3,000 m. elevation. Recent specimens have all been vegetative, and no blooming material has been collected since 1898. Known also from Venezuela.

AVENA Linnaeus

Caespitose annual grasses; inflorescence a solitary terminal panicle. Spikelets usually large, laterally compressed; glumes about as long as the entire spikelet, equal, many-nerved, papery; florets several; disarticulation above the glumes and usually between the several florets; lemmas rounded on the back, firm, 5-9-nerved; apex 2-toothed; awn usually present, originating on the back of the lemma above the middle. (Pooideae: Aveneae.)

Avena sativa L., Sp. Pl. 79. 1753. Figure 19.

Caespitose annual in small clumps; culms ca. 1 m. tall. Inflorescence an open pyramidal terminal panicle. Spikelets large, drooping, usually 3.5-4.5 cm. long; glumes equal, spreading at maturity, conspicuously nerved; florets usually 2-3, the upper ones shorter than the lowermost and the terminal one often abortive; callus sometimes short-bearded; back of the lemma glabrous; awn well developed and geniculate or reduced to a short rudiment in some strains; cultivated strains disarticulate tardily by a straight line of fracture at the base of each lemma.

Oats is grown as a grain crop in the temperate zone and the grain is frequently used for human food in the tropics as a breakfast cereal or in drinks. It is rarely cultivated at middle elevations on the volcanoes of the Meseta Central as a forage crop for dairy cattle, sometimes mixed with *Lolium*. Common names: *avena*, "oats."

AXONOPUS Beauvois

REFERENCES: G. A. Black, Grasses of the genus *Axonopus* (a taxonomic treatment), L. B. Smith, ed. Advancing Frontiers of Plant Sciences 5:vi + 186. 1963. M. C. M. Hickenbick, J. F. M. Valls, F. M. Salzano, & M. I. B. de Moraes Fernandes, Cytogenetic and evolutionary relationships in the genus *Axonopus* (Gramineae), Cytologia 40:185-204. 1975.

Perennial or annual caespitose or rhizomatous, often stoloniferous grasses of low to moderate stature. Peduncles 1-several from upper or terminal nodes; inflorescence of



FIG. 19. *Avena sativa*. A, panicle; B, spikelet; C, group of florets.

several-many digitate or paniculate slender racemes, the spikelets borne in two rows along the lower sides of a slender triquetrous or flattened rachis; pedicels very short; spikelets appressed to the rachis, each overlapping sequentially with the spikelets next above and below it. Spikelets placed with the second glume and back of the fertile lemma away from the rachis; first glume absent (except occasionally in *A. poiophyllus*); second glume and lower (sterile) lemma subequal, 2-5-nerved, concealing the upper (fertile) floret, slightly or considerably longer than the fertile floret; fertile lemma dorsally compressed, stiff, cartilaginous, usually faintly striate, glabrous or with a few short spicules at its tip, its margins slightly inturned over the equal palea of similar form and texture; lodicules 2, truncate; anthers usually 3; styles 2, separate, naked at the base; caryopsis flattened, elliptical.

Axonopus is a large genus of over 100 described species, confined to warm climates of the western hemisphere and introduced elsewhere. The plants could be confused with some species of *Paspalum* or *Digitaria* on casual examination. They differ from *Paspalum* and *Digitaria* in the placement of the spikelets with the fertile lemma away from the rachis, and from *Digitaria* in the presence of solitary spikelets at each node of the rachis. A relatively small number of the species have importance as forage grasses. In Costa Rica, *A. scoparius* (*Zacate imperial*), *A. compressus* (*Zacate amargo*), and *A. affinis* are all components of pastures. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Axonopus*

- 1a. Rachis of racemes beset with numerous elongated, stiff, golden hairs that surround spikelets 2
- 1b. Rachis of racemes scabrous or rarely sparsely hairy, lacking conspicuous golden hairs 3
 - 2a. Rachis ca. 0.5 mm. wide, spikelets not sunken into pockets; rachis bearing spikelets to the tip *A. aureus*
 - 2b. Rachis 1.0-1.5 mm. wide, spikelets sunken into pockets between the midrib and margin; rachis extended beyond the ultimate spikelet as a flattened naked point 2-3 mm. long, sometimes with a solitary abortive spikelet at its tip
A. chrysoblepharis
- 3a. Spikelets 1.2-1.6 mm. long; weak caespitose annual; culms 20-40 cm. tall
A. capillaris
- 3b. Spikelets 1.8-3.5 mm. long; perennials with hard bases, often rhizomatous or stoloniferous 4
 - 4a. Inflorescence of very numerous racemes (up to 100), racemose along rachis, up to 50 cm. long; internodes of culms up to 7 mm. thick *A. scoparius*
 - 4b. Inflorescence of 2-8 racemes borne on short common rachis; internodes of culms 3 mm. or less thick 5
- 5a. Spikelets 1.8-2.2 mm. long *A. purpusii*
- 5b. Spikelets 2.3-3.5 mm. long 6
 - 6a. Second glume exceeding fertile floret by 0.2 mm. or less; nerves of bracts obscured by dense bands of silky pubescence 7

- 6b. Second glume exceeding fertile floret by 0.2-1.2 mm.; nerves of bracts not obscured by pubescence 8
- 7a. Culm internodes 1-3, not entirely covered by leaf sheaths; spikelets 2.9-3.1 mm. long; bracts 2-nerved; anthers 1.5-1.8 mm. long; coastal savannas, Guanacaste
A. poiophyllus
- 7b. Culm internodes numerous, short, culms clothed by overlapping sheaths nearly to peduncle; spikelets 3.0-3.5 mm. long, bracts 4-5-nerved; anthers 2.2 mm. long; Volcán Rincón de la Vieja *A. volcanicus*
- 8a. Fertile floret 1.0-1.2 mm. shorter than the spikelet; second glume 3-nerved, lateral nerves projecting as short points, apex of the glume trifid; spikelets 3.0-3.6 mm. long *A. centralis*
- 8b. Fertile floret 0.3-0.7 mm. shorter than spikelet; second glume 2- or 4-nerved, lateral nerves not projecting; spikelets usually 2.4-2.7 mm. long 9
- 9a. Leaf blades linear with very blunt, rounded tips; fertile floret up to 0.4 mm. shorter than second glume; middle elevations, mostly in the Meseta Central .. *A. affinis*
- 9b. Leaf blades narrowly ovate, tapering from middle to an acute tip; fertile floret 0.3-0.6 mm. shorter than second glume; widespread at lower and middle elevations
A. compressus

***Axonopus affinis* Chase, J. Wash. Acad. Sci. 28:180. 1938.**

Perennial, caespitose or with stolons; culms unbranched, 20-60 cm. tall; internodes up to 2 mm. thick, pithy, glabrous; nodes glabrous or slightly bearded; sheaths compressed, glabrous except for the ciliate overlapping margin, the inner margin thin and fragile; ligule a ciliate membrane, in total 0.3-0.5 mm. long; leaf blades linear, flat or folded, 4-15 cm. long, 3-5 mm. wide, papillose-ciliate near the base, otherwise glabrous, the apex obtuse. Peduncles 1-2 from the terminal sheath, exerted up to 16 cm.; inflorescence 5-11 cm. long, of 2-7 divergent racemes on a short common rachis; individual racemes slender, 3.5-5.0 cm. long; rachis triquetrous, ca. 0.5 mm. wide, scabrous on the angles; spikelets subsessile, the pedicels less than 0.2 mm. long; spikelets overlapping sequentially one-third to one-half of their length. Spikelets 2.3-2.8 mm. long, elliptic-ovate, 2.4-2.7:1, acute, slightly pubescent on the margins of the glume and sterile lemma and at the apex; second glume and lower (sterile) lemma equal, exceeding the floret by 0.2-0.4 mm.; nerves 2, submarginal, the midnerve lacking; fertile floret stramineous; lodicules 2, truncate; anthers 3, purple, ca. 1.5 mm. long; styles 2, separate, naked at the base; stigmas 2, purple.

Pastures and open areas, mostly 1,700-2,200 m. elevation; Vara Blanca, Volcán Barba, San Ramón, Tarbaca. June to December. Widespread, southeastern United States to Argentina; introduced elsewhere.

This species, along with *A. compressus*, comprises an intricate and difficult taxonomic group, as yet poorly understood. My treatment should be regarded as tentative. I have named as *A. affinis* our specimens that have a chromosome number of $n = 50$ and which possess linear rather than narrowly ovate leaf blades. All have outer bracts that only slightly exceed the fertile lemma. Presence or absence of

stolons, often used as a character in *Axonopus*, is unreliable, as plants in dense turf, like those in pastures, frequently lack stolons.

Axonopus aureus Beauv., Ess. Nouv. Agrost. 12. 1812. *A. chrysites* (Steud.) Kuhlman, Comm. Linh. Electr. Estrat. Mato Grosso Amazonas 67, Anexo 5, Bot. pt. 11:88. 1922. *Panicum chrysites* Steud., Syn. Pl. Glum. 1:38. 1854. Figure 20.

Caespitose perennial in clumps from knotty crowns; plants 40-90 cm. tall, branching from the lower nodes, much of the foliage borne toward the base; internodes 1.0-1.5 mm. thick, hollow, glabrous, rarely with a few short golden bristles near the apex; nodes glabrous, dark, not prominent; lower sheaths overlapping, the upper shorter than the internodes, keeled, glabrous or papillose-hispid, the margins usually ciliate; ligule a dense ciliate fringe, usually less than 0.5 mm. long; leaf blades 8-15 cm. long, 4-7 mm. wide, glabrous or the margins and sometimes the surfaces papillose-hispid, a dense tuft of long hispid hairs occasionally just behind the ligule. Peduncles solitary, exserted 2-15 cm., terminal on erect leafy branches. Panicle vase-shaped, up to 9 cm. long, made up of 2-9 slender ascending racemes borne on a short central axis; racemes 4-9 cm. long; rachis triquetrous, ca. 0.5 mm. wide, strongly papillose-ciliate with stout golden hairs 2-3 mm. long; tufts of similar hairs borne on a transverse ridge just below the insertion of each spikelet; pedicels less than 0.2 mm. long; spikelets sessile in shallow excavations of the rachis, in 2 alternating rows on the 2 lower sides, each overlapping the next above by about one-third of its length. Spikelets elliptic-obovate 2:1, biconvex, glabrous, 1.2-1.5 mm. long; second glume and lower (sterile) lemma equal, as long as the spikelet, glabrous, usually purple, faintly 2-3-nerved; upper (fertile) lemma elliptical, cartilaginous, 1.2-1.3 mm. long, chestnut-colored, the palea similar, bulging; lodicules 2, truncate; anthers 3, purple, 0.8-0.9 mm. long; styles 2, separate; lodicules 2. Chromosome number $n = 10$ from a Costa Rican specimen.

Dry *Curatella-Byrsonima* savannas, and other open areas, especially on volcanic tuff, 200-1,100 m. elevation; occasional in Guanacaste, western Meseta Central (Hda. Argentina, Nuestro Amo, Rodeo de Pacaca, Paraíso); Buenos Aires, Boruca, Cañas Gordas. October to January. Mexico to Panama; northern South America to Brazil and Bolivia; West Indies.

Black has applied the name *A. chrysites* to this species, deeming the name *A. aureus* dubious. However, Chase (Proc. Biol. Soc. Wash. 24:135. 1911) discussed the application of the name *A. aureus* and fixed it in the sense used here.

Axonopus capillaris (Lam.) Chase, Proc. Biol. Soc. Wash. 24:133. 1911. *Paspalum capillare* Lam., Tabl. Encycl. 1:176. 1791. Figure 23.

Plants annual, caespitose, rather delicate; culms mostly 20-40 cm. long, often geniculate at the base and sprawling, branching freely from the base and lower nodes; internodes slender, 0.7 mm. or less thick, hollow, glabrous; nodes glabrous or minutely bearded; leaf sheaths shorter than the internodes, glabrous except for the short-ciliate overlapping margin; ligule a densely ciliate membrane, 0.3-0.5 mm. long; leaf blades

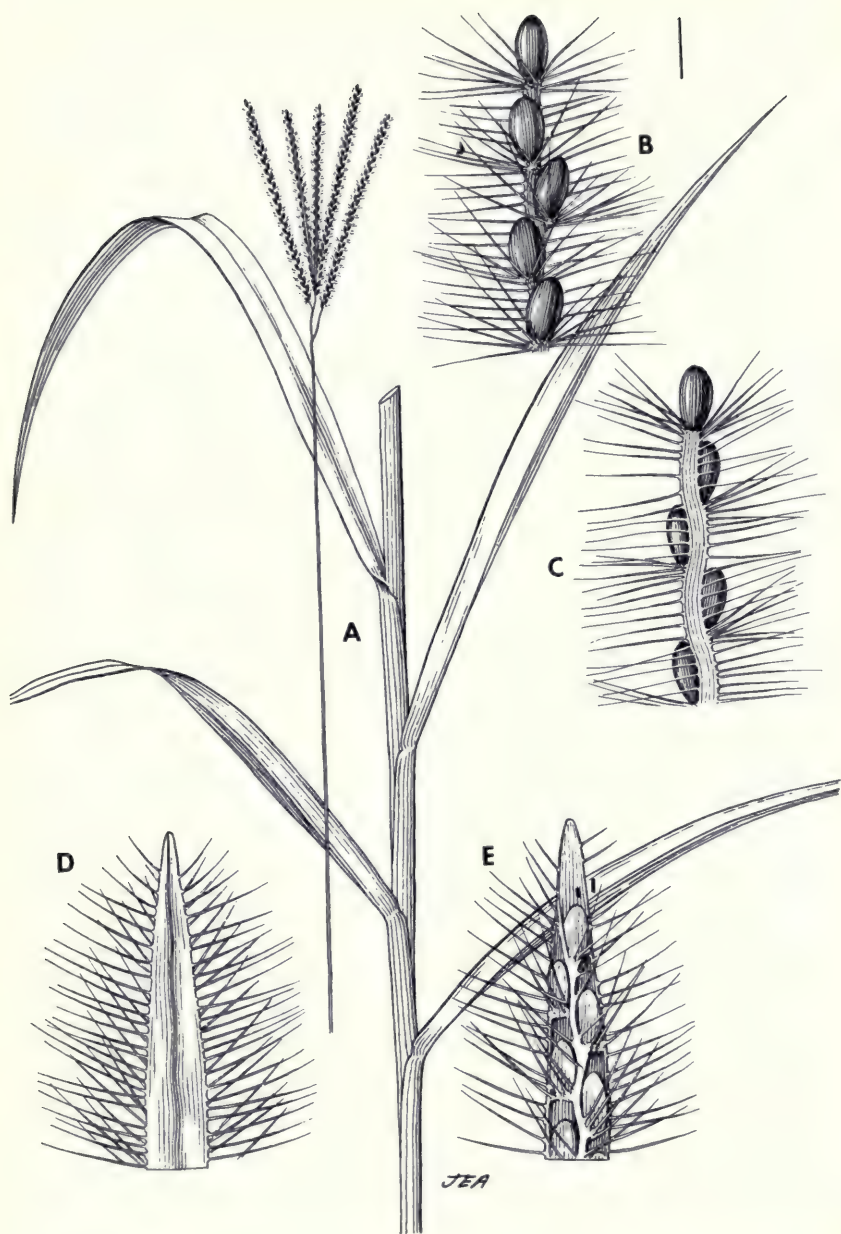


FIG. 20. *Axonopus* species. *A. aureus*: A, culm and inflorescence; B, C, rachis and spikelets; *A. chrysoblepharis*: D, E, tip of rachis and spikelets.

flat, tapering from a broad base, 1.5-7.0 cm. long, 3-7 mm. wide, the length $5-12 \times$ the width, glabrous except for a few marginal cilia near the base. Peduncles slender, arcuate, 1-3 from the terminal sheath and sometimes others from the upper leaf axils, exerted up to 15 cm.; inflorescence of 2 conjugate divergent racemes 2.0-3.5 cm. long borne at the apex of the peduncle, often a third borne a short distance below; racemes very slender, the triquetrous rachis less than 0.5 mm. wide, scabrous on the angles, undulate; spikelets borne in 2 rows on the lower 2 sides of the rachis, each one barely overlapping the base of the next above in sequence. Spikelets obovate 2.3-2.5:1, minutely puberulent, 1.2-1.6 mm. long, stramineous or purplish; second glume as long as the spikelet, 4-nerved, lacking a midrib; sterile lemma similar, 2-nerved; upper (fertile) lemma about as long as the spikelet, faintly striate, its palea similar; anthers 3, purple, 0.4 mm. long; styles 2, separate; stigmas purple; caryopsis amber, elliptical 2:1, 1.1 mm. long. Chromosome number $n = 10$, 20 from Costa Rican specimens.

Somewhat weedy; beaches, roadsides, pastures. Playas del Coco, San Ramón area, Turrucare, Alajuela, San José. September to January. Honduras and El Salvador, Costa Rica and Panama to northern South America, southward to Peru, Brazil, and Paraguay; Lesser Antilles.

Black (1963) states that some specimens have pilose foliage, but ours are nearly glabrous.

Axonopus centralis Chase, J. Wash. Acad. Sci. 17:143. 1927. Figure 24.

Caespitose perennial; culms 35-80 cm. tall, erect or spreading, unbranched; internodes 1.5-3.0 mm. thick, pithy, glabrous; nodes glabrous or minutely woolly; leaf sheaths keeled, longer than the internodes, the overlapping margin ciliate, the other margin very thin and fragile; collar more or less pubescent; ligule a minute ciliolate rim, 0.2-0.3 mm. long; leaf blades rather thin, flat, 8-50 cm. long, 8-13 mm. wide, papillose-ciliate at the base and with occasional appressed hairs on the upper surface. Peduncles 1-2 from the uppermost sheath, slender and arcuate, exerted up to 27 cm., slightly woolly at the apex; inflorescence usually of 2-3 ascending racemes borne on a common rachis up to 6 cm. long; racemes slender, 7-13 cm. long; rachis triquetrous, the spikelet-bearing sides ca. 0.7 mm. wide, the third side narrower; spikelets overlapping sequentially about one-third. Spikelets 3.4-3.6 mm. long, very flat, ovate 3.1-3.5:1, the apex rather blunt; second glume trifid at the tip, the 2 lateral nerves exerted as short points; lateral nerves submarginal, flanked on both sides by a silky band; midnerve usually present but faint; lower (sterile) lemma similar to the glume but slightly shorter, the apex acute; upper (fertile) floret much shorter than the outer bracts, 1.9-2.1 mm. long, elliptical 2.1:1, glabrous, stramineous; palea similar to the lemma; anthers 3, brownish and shriveled, ca. 0.6 mm. long; caryopsis elliptical, 2.0-2.5:1, tan, 1.4-1.6 mm. long.

In light shade, northwestern Guanacaste, Hda. Las Animas, Hda. Palo Verde, Finca la Pacifica, Playa Tamarindo; elevations from sea level to 200 m. June to December. Southwestern Mexico to Panama; Ecuador to Venezuela.

In several of the specimens examined, the anthers were trapped

within the fertile floret at the apex of a well-developed caryopsis. They were shriveled and contained shrunken or empty pollen grains. It is probable that this species is apomictic or cleistogamous.

Axonopus chrysoblepharis (Lag.) Chase, Proc. Biol. Soc. Wash. 24:134. 1911. *Cabrera chrysoblepharis* Lag., Gen. & Sp. Nov. 5. 1816. Figure 20.

Duration indefinite, possibly annual; caespitose; plants 70-100 cm. tall, erect; culms branching freely from lower and middle nodes; internodes 1-2 mm. thick, hollow, glabrous, golden colored; nodes glabrous or bearded with short golden hairs; leaf sheaths nearly glabrous to pilose or pustulose-hispid; ligule a ciliate membrane, 0.3-1.2 mm. long; leaf blades flat, 5-30 cm. long, up to 15 mm. wide, marginally pustulose-hispid, the surfaces more or less pilose and sometimes papillose-hispid as well. Peduncles terminal on the main culm or leafy erect branches, exserted 7-26 cm.; inflorescence a vase-shaped group of 4-10 slender ascending racemes borne on a short common rachis 1-2 cm. long. Rachis of individual spikes triquetrous, the back side 1-1.5 mm. wide, with a conspicuous flattened midrib and thickened margins that are densely pustulose hispid-ciliate with conspicuous golden hairs 2-3 mm. long; midrib produced between the spikelets as a thickened corky ridge, also bearing pustulose hairs; tip of rachis prolonged beyond the spikelets as a naked flattened point 2-3 mm. long, sometimes bearing a solitary abortive spikelet on its tip; spikelets sunken into cavities between the midrib and margins of the rachis, each spikelet overlapping the next in sequence by about one-half. Spikelets 1.4-1.6 mm. long, ovate 2.1-2.7:1; second glume and sterile lemma similar, with 2 submarginal nerves, equal in length and barely exceeding the fertile floret; texture of bracts very thin, revealing the brown color of the fertile floret; fertile lemma brown, 1.3-1.5 mm. long; anthers 3, purple, 0.5-0.6 mm. long; styles 2, separate; stigma purple. Chromosome number $n = 10$ or $10 + 2b$ from Costa Rican and Venezuelan specimens.

Rare; dry savannas. We have seen Pittier & Tonduz specimens collected before 1900 from Boruca, Mano de Tigre, and Cañas Gordas. Our sole recent specimen was from the Boruca savannas. November to February. Guatemala to Panama and northern South America, to Peru, Bolivia, Brazil, and Paraguay; Trinidad.

Axonopus compressus (Swartz) Beauv., Ess. Nouv. Agrost. 154. 1812. *Milium compressum* Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Figure 21.

Perennial; stoloniferous or caespitose (especially when crowded in turf), usually branching from the base or from rooted stolons; culms 1-3 mm. thick; internodes glabrous, hollow; nodes glabrous or appressed bearded; sheaths keeled, usually glabrous but the overlapping margin ciliate, the collar often with a pubescent line; ligule a short ciliate membrane, in total 0.2-0.5 mm. long; leaf blades flat, thin or firm, 8-26 cm. long, 7-13 mm. wide, narrowly ovate, tapering from below the middle to an acute apex, papillose-ciliate on the lower margins and sometimes with scattered weak appressed hairs on the upper surface. Peduncles 1-2 from the uppermost sheath, exserted up to 17 cm.; inflorescence of 2-6 divergent slender racemes borne on a short common rachis; pedicels very short, usually less than 0.2 mm. long. Spikelets overlapping sequentially one-fourth to one-third of their length, 2.4-2.7 mm. long, ovate, acute, the second glume



FIG. 21. *Axonopus compressus*. Plant with inflorescences, spikelet, and fertile floret.

and lower (sterile) lemma 0.3-0.7 mm. longer than the upper (fertile) floret; both bracts with 2 submarginal nerves and more or less pilosity along both sides of the nerves; fertile lemma stramineous, its palea similar; lodicules 2, truncate; anthers 3, purple; caryopsis tan or white, elliptical, 1.0-1.6 mm. long, flattened.

Widespread and common in pastures and open areas, open shade, usually in moist sites; sea level to 1,400 m. Probably blooming year-long. Widespread in warmer parts of the World.

Axonopus compressus is complex and highly variable, with many morphological races and several chromosomal levels. It is unlikely that this and related species can be properly understood without extensive cytological, genetic, and cultural studies. My treatment should be regarded as tentative. Among our specimens that have known chromosome numbers, I have been able to recognize roughly several groups based upon chromosome numbers and morphology; however, many cytologically unknown specimens can only be placed very approximately with one or another of these groups. Descriptions of the principal differences among these cytotypes are given below.

$n = 40$. Plants 45-135 cm. tall; leaf blades $12-22 \times$ longer than wide; spikelets ovate 2.7-2.8:1; anthers 1.0-1.3 mm. long. Known Costa Rican specimens are from elevations above 1,300 m. in the Meseta Central.

$n = 20$. Plants 20-60 cm. tall; leaf blades mostly $8-11 \times$ longer than wide, thin; spikelets ovate, 2.8-3.3:1; anthers 0.5-0.7 mm. long, brown to purplish. Widespread, sea level to 1,100 m. elevation.

$n = 30$. One specimen so determined from the Siquirres area (*Pohl & Davidse 11463*) has heavily bearded nodes and leaf blades prominently ciliate for their full length; second glume 4-nerved.

Axonopus poiophyllus Chase, Proc. Biol. Soc. Wash. 24:133. 1911. *A. blakei* Hitchc., Proc. Biol. Soc. Wash. 40:85. 1927. *A. rhizomatosus* Swallen, J. Wash. Acad. Sci. 23:458. 1933. Figure 22.

Perennial, caespitose or with short, knotty rhizomes; culms 25-100 cm. tall, erect, unbranched; foliage mostly basal, the lower sheaths overlapping; culm internodes 1-3, up to 3 mm. thick, hollow; nodes appressed-bearded; leaf sheaths keeled, more or less papillose-hirsute above the nodes and at the apex; overlapping margins ciliate; ligule a minute ciliate fringe, 0.3-0.5 mm. long; leaf blades flat or folded, 13-33 cm. long, up to 5 mm. wide, the uppermost one much reduced. Peduncles solitary or 2 from the uppermost sheath, exerted 6-25 cm.; inflorescence of 3-7 ascending racemes borne on a common axis up to 4 cm. long; racemes up to 11 cm. long, the slender triquetrous undulate rachis ca. 0.5 mm. wide, scabrous and with a few scattered elongate hairs; spikelets borne on short pedicels less than 0.5 mm. long; spikelets overlapping sequentially about one-third, 2.5-2.8 (-3.1) mm. long, ovate 2.9-3.1:1; first glume absent or if

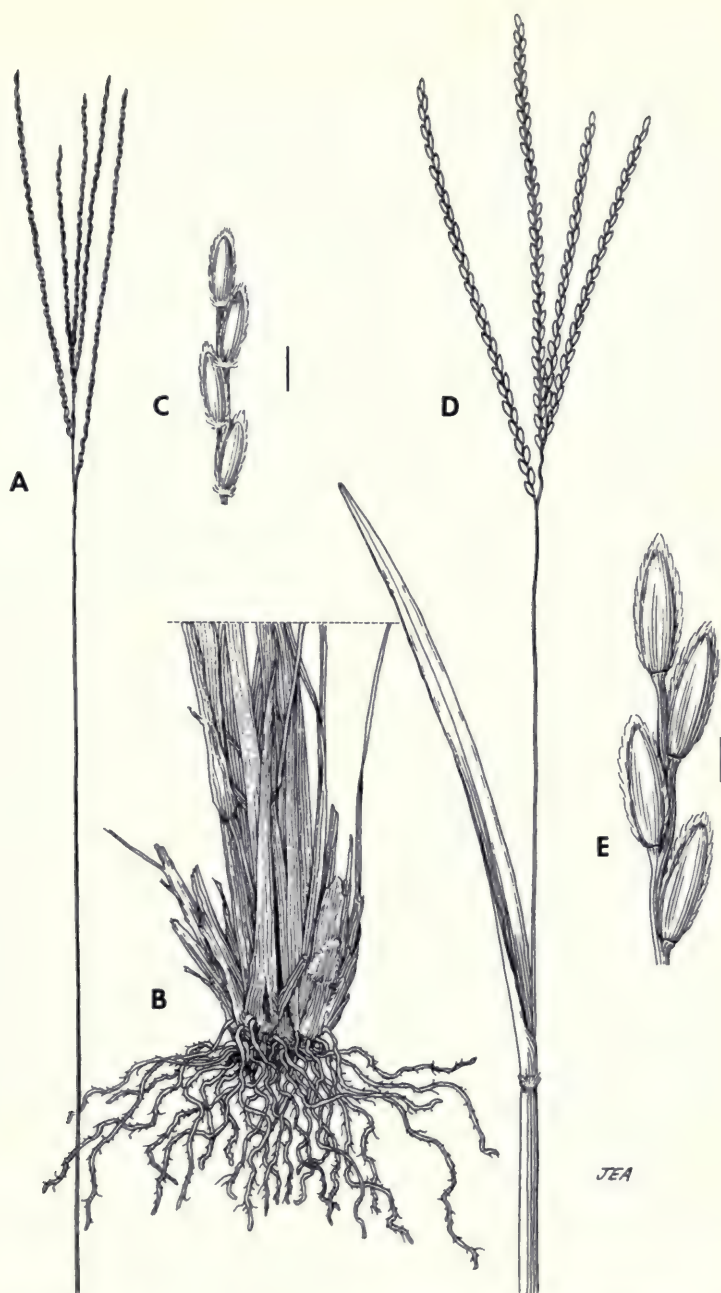


FIG. 22. *Azonopus* species. *A. purpusii*: A, inflorescence; B, base of plant; C, portion of raceme with spikelets; *A. poiophyllus*: D, inflorescence; E, portion of raceme with spikelets.

present, narrowly triangular, up to 2.5 mm. long, 1-5-nerved; second glume and lower (sterile) lemma equal, as long as the spikelet, 2-nerved, silky near the margins and at the base; upper (fertile) lemma slightly shorter than the outer bracts, ovate 2.7-2.8:1, faintly striate, ciliate at the tip; anthers 3, purple, 1.5-1.8 mm. long; styles 2, separate; stigmas purple. Chromosome number $n = 30$ from Costa Rican and Honduran specimens.

Dry *Curatella-Byrsonima* savannas on volcanic tuff, mostly at elevations under 200 m.; northern Guanacaste south to Bagaces. June to July; January. Southern Mexico to Honduras; Colombia; Cuba.

We have previously confused this species with the endemic *A. volcanicus* from Rincón de la Vieja. In addition to the differences stated in the key, they differ in chromosome number. Spikelets in the genus *Axonopus* lack a first glume, and the occurrence of this structure in some of our specimens of *A. poiophyllus* is apparently unique.

***Axonopus purpusii* (Mez) Chase, J. Wash. Acad. Sci. 17:144. 1927.**
Paspalum purpusii Mez, Bot. Jahrb. 56, Beibl. 125:10. 1921.
Axonopus anomalus Swallen, Contr. U.S. Natl. Herb. 29:268. 1949.
Figure 22.

Densely caespitose perennial; culms 50-80 cm. tall, erect, simple; internodes 1-2, elongated, less than 1 mm. thick, glabrous; nodes dark, not enlarged, glabrous or rarely sparsely appressed-bearded; foliage mostly basal, the culms rather naked; sheaths keeled, much shorter than the internodes, glabrous to densely pilose, the overlapping margin ciliate; ligule a densely ciliate rim, in total 0.3-0.6 mm. long; collar usually pilose; blades 15-25 cm. long, 2-4 mm. wide, more or less papillose-pilose, the tip abruptly rounded; uppermost blade usually much reduced; basal foliage frequently burned off in herbarium specimens. Peduncles 1-2, exserted 12-17 cm. from the apical sheath, very slender; inflorescence 8-11 cm. long, vase-shaped, of 3-6 slender ascending racemes borne on a short common rachis 1-3 cm. long; racemes 4-8 cm. long, woolly at the base; rachis slender, 0.3-0.5 mm. wide, undulate, scabrous on the angles and with scattered long hairs at the nodes; spikelets subsessile, the pedicels 0.3 mm. or less long. Spikelets overlapping sequentially for one-third to one-half their length, 1.8-2.2 mm. long, oblong-ovate 2.5-3.3:1; second glume and lower (sterile) lemma similar, as long as the spikelet, 2-nerved submarginally, the nerves mostly concealed by dense silky appressed hairs that extend to 0.3 mm. beyond the acute tip of the bracts; upper (fertile) lemma ovate ca. 2.4:1, stramineous, faintly striate, with a few minute spicules at its tip; palea similar; lodicules 2, truncate; anthers 3, purple, 1.2 mm. long; styles 2, separate; stigmas light-colored. Chromosome number $n = 10$ from a Costa Rican specimen.

Dry savannas, especially with *Curatella* and *Byrsonima*; northern Guanacaste, between Liberia and La Cruz; savannas of Buenos Aires; elevations 75-380 m. March to August. Southern Mexico to Panama; northern South America to Bolivia, Brazil, Paraguay, and Argentina.

***Axonopus scoparius* (Flügge) Kuhlman, Comm. Linh. Telegr. Estrat. Mato Grosso Amazonas, Publ. 67, Anexo 5, Bot. 11:45. 1922.**
Paspalum scoparium Flügge, Gram. Monogr. 124. 1810. Figure 23.

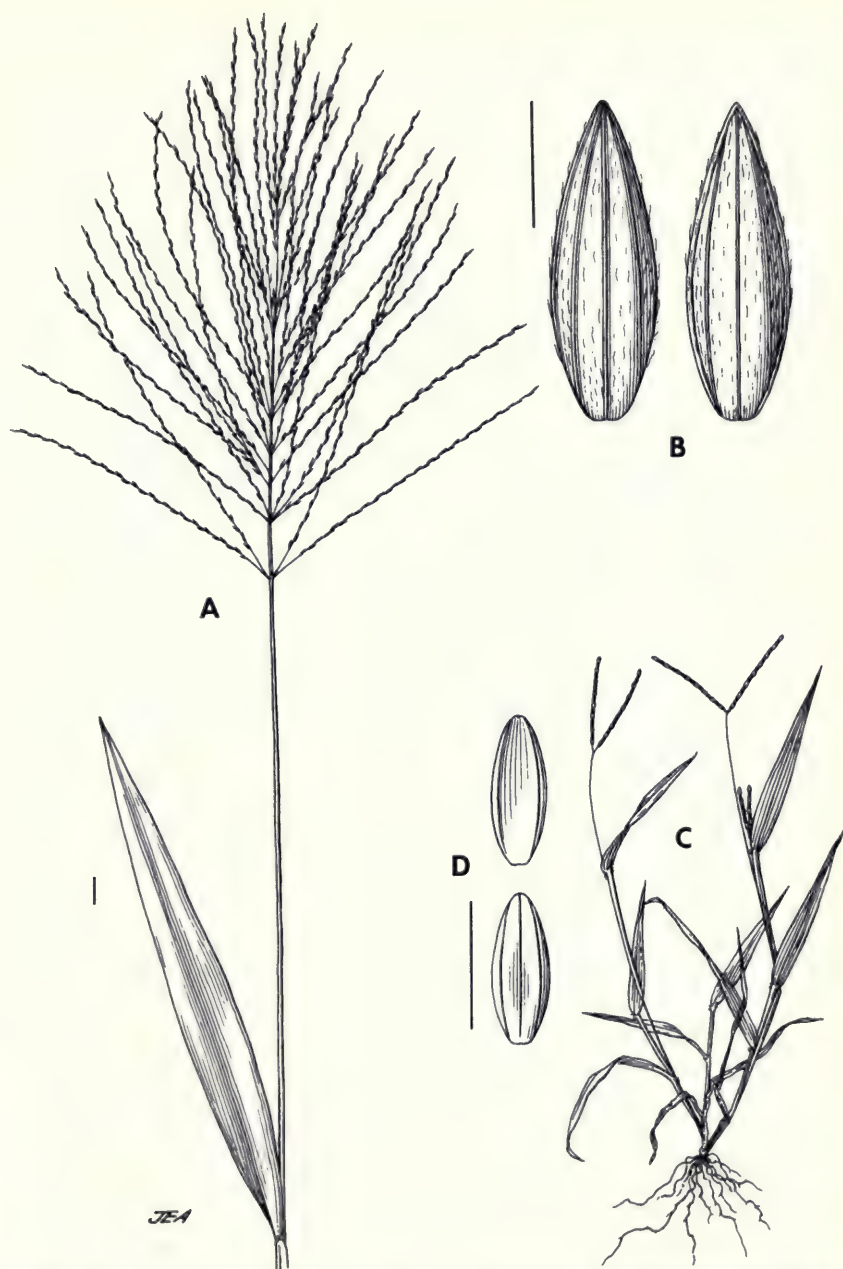


FIG. 23. *Axonopus* species. *A. scoparius*: A, inflorescence; B, spikelets, both sides; *A. capillaris*: C, blooming plant; D, spikelets, both sides.

Tall, vigorous perennial from a matted crown; culms erect, to 1.5 m. tall; plants sometimes producing lengthy coarse stolons when pendent on steep slopes; culms occasionally branched; internodes up to 7 mm. thick, solid, pithy, glabrous; lower leaf sheaths closely overlapping, strongly keeled, glabrous; ligule a thick membrane, bearing short cilia, in total 1.0-2.7 mm. long; dewlap conspicuous, yellowish; collar bearing a line of short, stiff hairs; leaf blades flat, 15-50 cm. long, 0.5-3.0 cm. wide, tapering to an acute apex; lower surface glabrous; upper surface papillose-hirsute. Peduncle included or exerted up to 30 cm.; inflorescence a terminal panicle made up of numerous simple or rarely branched spreading or ascending racemes; panicle open, dome-shaped, often purplish, usually 15-30 cm. long and nearly as wide; individual racemes to 12 cm. long; rachis of racemes slender, triquetrous, strongly scabrous on the angles and sometimes with a few longer hairs; pedicels stiff, appressed, scabrous, less than 1 mm. long; spikelets borne in 2 rows appressed to the lower sides of the rachis; successive spikelets overlapping by about one-third. Spikelets 2.7-2.9 mm. long, ovate 2.5-3.3:1, acute or rather blunt, usually purple; second glume and lower (sterile) lemma equal, as long as the spikelet, covering and concealing the upper (fertile) floret, both sparsely appressed pubescent between the nerves; upper (fertile) floret 2.2-2.4 mm. long, oblong, rather blunt; lemma cartilaginous, stramineous, its apex bearing a few minute spicules, the margins slightly inrolled over the edges of a similar palea; lodicules 2, truncate; anthers 3, purple, 1.5-1.7 mm. long; styles 2, stigmas purple. Chromosome number $n = 10$ from Costa Rican specimens.

This species is widely cultivated in moister parts of the Meseta Central and on the volcanoes of the Cordillera Central, at elevations up to 2,500 m. It appears to persist after cultivation or to spread freely to field margins and road embankments. Black reports *A. scoparius* from Mexico to Peru, without indicating whether part of this range is due to spread in cultivation.

None of our specimens has mature seed, and caryopses are apparently rarely produced. In cultivation, the plants are reproduced by cuttings or by placing culms in furrows as is done with sugar cane.

The species is widely cut as green feed for dairy cattle and produces tremendous yields of forage under optimum conditions. Common name: *Zacate Imperial*. We have seen a strain with purple leaves cultivated near Pacayas.

***Axonopus volcanicus* Pohl, *sp. nov.* Figure 24.**

Axonopus poiophyllo Chase similis, sed ab eo folii numerosis (6-11), vaginis imbricatis, spiculis longioribus (3.0-3.5 mm.), nervis glumae secundae et lemmatis sterilis 4-5, numero chromosomico $n = 19$ recedens.

Densely caespitose perennial, forming thick sods; culms erect, 30-80 cm. tall, branching freely from the base and lower nodes; internodes compressed, to 3 mm. thick, hollow with a small lumen or solid and pithy, glabrous; leaf sheaths keeled, closely overlapping and clothing most of the culm; collar, keel, and margins silky ciliate, especially near the apex; ligule a minute membrane, densely ciliate with silky white hairs, in total 0.7-0.9 mm. long; leaf blades 6-11 per culm, 9-20 cm. long, 4-7 mm. wide, long-pubescent on the

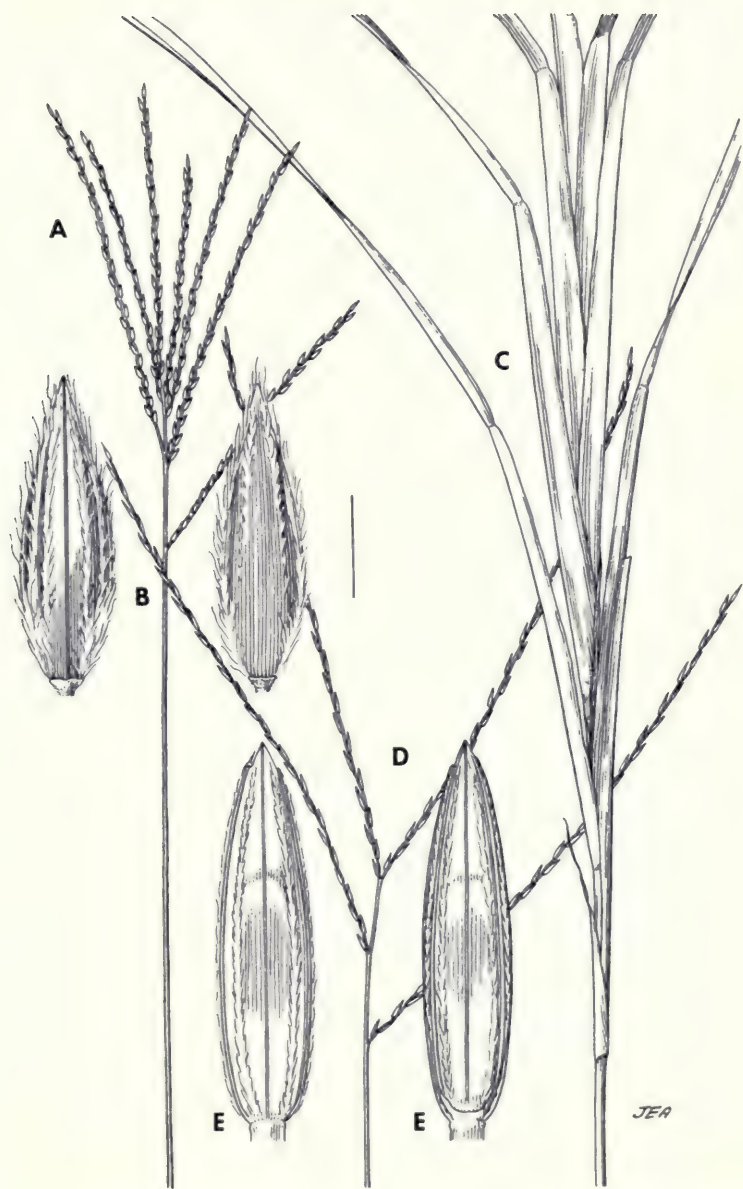


FIG. 24. *Azonopus* species. *A. volcanicus*: A, inflorescence; B, spikelets, both sides; C, culm invested with leaves; *A. centralis*: D, inflorescence; E, spikelets, both sides.

upper surface above the ligule; margins papillose-ciliate with long coarse hairs to 4 mm. long; midrib sometimes pubescent above; margins scaberulous; midrib prominent beneath; tip of blade blunt, boat-shaped. Peduncles exserted 6-15 cm.; inflorescences 1-2 from the terminal sheath; composed of 3-8 ascending racemes borne on a common rachis 1-3 cm. long; inflorescence 6-14 cm. long, the individual racemes 6-13 cm. long, minutely bearded at the base, spikelet-bearing nearly to the base; rachis triquetrous, ca. 0.5 mm. wide, scabrous on the angles and with a few scattered elongated papillose-based hairs; pedicels 0.3-0.5 mm. long. Spikelets overlapping sequentially about one-third their length, 3-3.5 mm. long, ovate 2.8-3.1:1, silky on the margins of the bracts and at the base, often purplish; second glume and lower (sterile) lemma equal, as long as the spikelet and slightly exceeding the tip of the fertile lemma, 4-5-nerved, the nerves usually submarginal, a weak midrib present or absent; upper (fertile) lemma 2.5-3.1 mm. long, elliptic, stramineous, faintly striate, with a tuft of short cilia at the tip; palea similar; lodicules 2, truncate, fleshy; anthers 3, purple, 2.2 mm. long; styles 2, separate; stigmas purple. Immature caryopses seen.

A large, dense stand of this species occurs above timberline on the west face of Rincón de la Vieja, at a locality on Hacienda Guachipelin known as Los Copelares. It also occurs around a fumarole called Las Hornillas. In both cases, chromosome counts indicate $n = 19$. We have previously considered that these plants were conspecific with *A. poiophyllus* Chase, which, according to our counts, has 30 pairs of chromosomes. Both populations, however, differ from that species in having longer, more densely silky spikelets with 4-5 nerves on the bracts, typical *A. poiophyllus* having 2-nerved bracts. More strikingly, the montane *A. volcanicus* has a much larger number of foliage leaves per culm, their sheaths densely clothing the stems nearly to the inflorescence. *Axonopus poiophyllus* typically has 1-3 culm blades and more or less exposed internodes. None of our specimens has spikelets with first glumes, while the common lowland *A. poiophyllus* in the region frequently has them. The peculiar aneuploid chromosome number of *A. volcanicus* suggests that it is a recent derivative that is successful in the rather extreme habitats of Rincón de la Vieja.

SPECIMENS SEEN: HOLOTYPE: Costa Rica; Prov. Guanacaste, La Hornillas, Volcán Rincón de la Vieja, Hda. Guachipelin, elevation 750 m., 17 January 1969, $n = 19$, Pohl & Davidse 11667, ISC 277812. OTHER SPECIMENS: Prov. Guanacaste, Los Copelares, Volcán Rincón de la Vieja, Hda. Guachipelin, above timberline on W side of volcano, elevation 1,400 m., 30 July 1971, $n = 19$, Pohl 12662. Another sheet from the same locality: Burger & Pohl 7763.

BAMBUSA Schreber

Caespitose bamboos of medium to tall stature; culms hollow or sometimes nearly solid; culm sheaths early deciduous; branches unarmed or with stout straight or hooked

branch thorns; branches 1-several per node, one usually larger than the others; foliage blades without conspicuous commissural veins. Inflorescence spicate, of sessile, clustered pseudospikelets, these with basal prophylla and bracts, the lower glumelike, enclosing branch buds and short paleas or true spikelets; pseudospikelets continued without interval into several-flowered spikelets, their lemmas many-nerved, the paleas about as long as the lemma; lodicules 3, flat, vasculated, ciliate; anthers 3 or 6; style 1, stigmas 2 or 3.

As treated by McClure (1973), thorny American bamboos previously considered as constituting the genus *Guadua* Kunth, are here included as subgenus *Guadua* (Kunth) McClure. Subgenus *Bambusa* consists of Asiatic bamboos, either thorny or not, many of which are cultivated in the American tropics. In addition to the species treated here, others may be found in cultivation. (Bambusoideae: Bambuseae.)

KEY TO SPECIES OF *Bambusa*

- 1a. Culm branches with straight or hooked thorns; internodes not striped 2
- 1b. Culm branches lacking thorns; culms usually longitudinally striped with green and yellow *B. vulgaris*
- 2a. Culms up to 3 cm. thick, 5 m. tall; pseudopetioles less than 1 mm. long, leaf blades 10 mm. or less wide; native, dry savannas, northern Guanacaste
B. paniculata
- 2b. Culms up to 15 cm. thick, 30 m. tall; pseudopetioles 2-5 mm. long, leaf blades 10-18 mm. wide; cultivated Asiatic species *B. arundinacea*

***Bambusa arundinacea* Willd., Sp. Pl. 245, 1799, *sensu* Gamble, Ann. Roy. Bot. Gard. Calcutta 7:51, pl. 48. 1896. Figure 25.**

Giant caespitose bamboos in large dense clumps; culms up to 30 m. tall and 10-15 cm. thick, nearly erect; internodes cylindrical, green, densely glaucous when young with siliceous powder; lower nodes ciliate with brown hairs; culm sheaths deciduous, coriaceous, glabrous outside, sheath blades as wide as the sheath apex, broadly triangular, erect, the abaxial surface glabrous, the adaxial surface densely hispid with blackish hairs; ligule a short thick ciliolate membrane, 1-2 mm. long; lower nodes of the culms producing numerous weak spreading thorny branches; foliage-bearing branchlets 1-3 per node, solid, frequently with 1-several straight or hooked thorn-branches arising at their bases; sheaths on foliage-bearing branchlets overlapping, glabrous except for the ciliolate margin; auricles ciliate with light-colored bristles up to 6 mm. long; external ligule prominent, coriaceous; pseudopetioles 2-5 mm. long; margins of blades white-banded; surfaces glabrous, slightly glaucous, 7-18 cm. long, 10-18 mm. wide, leaves crowded towards the tips of the branchlets, the sheaths overlapping. Inflorescences large, covering at least the terminal 5 m. of the culms; pseudospikelets subsessile, 1.5-2.0 cm. long, their bases enclosed by prophylls, clustered at the nodes of slender naked branchlets up to 50 cm. long, usually 2-5 per node of the slender rachis, with several short prophylla at the base, branching into true spikelets that are continuous with the basal bracts and prophylls; prophylla 4-5 mm. long, ciliate on the keels, no definite "glumes" above the basal bracts; true spikelets disarticulating above the basal bracts and between florets; lemmas broad, ca. 15-nerved, rounded on the back, mucronate, 8-9 mm. long, the margins short-ciliate, enveloping the rachilla at the base; palea conspicuously ciliate on



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FIG. 25. *Bambusa arundinacea*. A, pseudospikelet; B, portion of inflorescence; C, twig node with branch thorns; D, base of seedling.

the keels, as long as the lemma or slightly longer; rachilla internodes short, flattened; florets 5-7, the uppermost reduced; lodicules 3, flattened, vasculated, broadly spatulate, long-ciliate at the tip; anthers 6, yellow, 4-5 mm. long; style 1; stigmas 3, plumose; caryopsis plump, ovate-fusiforme, acute, tan, 7.0-7.5 mm. long, 2.5 mm. wide; embryo 1.5 mm. long; style base persistent; adaxial groove conspicuous, running the full length of the caryopsis.

The above inflorescence and spikelet description was taken from a specimen collected by Mayra Montiel de B., 13 May 1974. I have visited the same colony on the estate of Dr. Antonio Peña Chavarría in Rio Segundo. The clump was dense, 10-12 m. in diameter and the erect to arching culms reached 20-30 m. in height. Individual culms were 10-12 cm. thick. The internodes of young culms were densely whitened with siliceous powder (tabasheer). This clump began to bloom in 1974 and the specimen collected by Sra. Montiel de B. in May had intact inflorescences. When I saw it in December 1974, most of the clump was still vegetative, but many culms were dead and the spikelets had shattered. The gardener stated that the clump was at least 25 years old and that this was the first flowering. The plants produced prodigious quantities of fallen spikelets. Many of the florets were sterile and empty. An analysis of florets collected under this clump, performed by the Iowa State Seed Laboratory, indicated that nearly 20 per cent of the material contained caryopses. Enough caryopses were produced that the seedlings constituted a weed problem in the flower beds near the clump. Seedlings 25-30 cm. tall were already present and were producing short rhizomes or tillers.

This species, of Asiatic origin, is occasionally cultivated in Central America, but is disliked because of the thorns. A large clump occurs in the bamboo grove of the CATIE of Turrialba. Blooming during the 1974-1975 period is known from Panama and other parts of Central America.

***Bambusa paniculata* (Munro) Hack., Oesterr. Bot. Z. 53:195. 1903.**
Guadua paniculata Munro, Monogr. Bamb. 85. 1868. Figure 26.

Long-lived perennial bamboo; blooming rare; plants caespitose in dense clumps of 10-20 culms; culms 5-10 m. tall, erect below, the upper portions stiffly arching, branching freely from the middle and upper nodes, the branches spreading horizontally; culms up to 2.5 cm. thick, very thick-walled or solid, green when immature, yellow at anthesis; internodes cylindrical, grooved on the side toward the bud or branch; nodes with a prominent sheath girdle and swollen supranodal ridge; apex of internodes appressed-velvety; one principal branch per node, accompanied by 1-2 smaller ones and stout straight thorn branches up to 2 cm. long. Primary branches from culms spreading, their naked internodes hollow, bearing secondary leaf-bearing branches in clusters of 6-10, their internodes retrorsely puberulent; sheaths ciliolate on the overlapping margins; auricles truncate, bearing numerous brownish flexuous bristles up to 7 mm. long;



FIG. 26. *Bambusa paniculata*. A, spikelet-bearing branches with nodal thorns; B, pseudospikelet; C, thick-walled culm with a major branch.

pseudopetioles less than 1 mm. long, hispidulous with erect hairs on the lower surface, these hairs continued onto the midrib of the blade; blades flat, ovate 10-17:1, acuminate, 3-14 cm. long, 4-10 mm. wide. Inflorescences solitary at the tips of minor, leaf-bearing branchlets, each consisting of 1 or 2 pseudospikelets, the base sometimes included in the ultimate leaf sheath; pseudospikelets 2-3.5 cm. long, the basal 1 or 2 bracts glumelike, shorter than the florets, with a reduced axillary prophyllum and a bud or axillary spikelet; remainder of the pseudospikelet consisting of up to 12 normal florets; rachilla disarticulating between florets; lemmas 6-7 mm. long, usually 11-nerved, broadly ovate, mucronate; palea at least three-fourths as long as its lemma, broadly winged, multi-nerved, ciliate on the keels; lodicules 3, flat, ovate, vasculated, ciliate at the tip; anthers 3, ca. 4 mm. long, yellow; ovary swollen and hardened, style 1, stigmas 3; caryopsis tan, obovate, 3:1, 4.0-4.5 mm. long, the embryo ca. one-fourth as long, the style base persistent.

This species is common on low elevation savannas in Guanacaste. Since the lower parts of the culms are often solid, it may be misidentified as a species of *Chusquea*, but can usually be differentiated by the thorns. The smaller lateral branches of the culms seem to be regularly hollow. We have collections from N of Bagaces, 10 km. S of La Cruz, and Hacienda Murcielago. The only flowering colony seen was on the road to Hacienda los Inocentes, 3 km. E of the CIA. At this site, and also further east on the same road, a large colony was in flowering or fruiting condition in 1976. The plants were all dying. An immediately adjacent colony, with slightly different foliage, was completely vegetative. Fruiting specimens from this colony are *Pohl & Pinette 12329* (ISC, US, F, CR).

***Bambusa vulgaris* Schrad. ex Wendl., Coll. Pl. 2:26, p. 47. 1810.**
Figure 27.

Clumps large, open, the culms erect to arching, 10-15 m. long; internodes cylindrical, up to 10 cm. thick, rather thin-walled, yellow or striped with yellow and green; nodes not prominent, usually brown-ciliate; sheaths of main culms 15-25 cm. long, 18-23 cm. wide, appressed-hispid above with brown hairs; sheath blades triangular, acute, 5-15 cm. long, up to 10 cm. wide, appressed pubescent on both inner and outer surfaces; auricles rounded, bristly-ciliate; ligule 5-8 mm. long; sheaths of foliage leaves pubescent, their rounded auricles bearing a few bristles; ligule short, ciliate; leaf blades flat, 15-25 cm. long, 18-43 mm. wide, their surfaces usually glabrous when mature; edges and marginal nerves scabrous; pseudopetiole ca. 5 mm. long. Inflorescence large, leafy, compound, the spikelike branches with fascicled clusters of pseudospikelets at the nodes; pseudospikelets ca. 2 cm. long, subtended by short ciliate prophylls and basal bracts (glumes?) that subtend lateral spikelets, the rachilla continuing into a true spikelet, without evident glumes; florets 6-10, some of them sterile; lemmas many-nerved, ca. 10 mm. long, broadly ovate, acute, the upper margins ciliate; palea about as long as the lemma, narrowly oblong, pectinate-ciliate, the hairs longest near the tip; rachilla segments clavate; lodicules 3, oblong, long-ciliate toward the tip; anthers 6, ca. 5 mm. long; style elongate, ciliate to the base; stigmas 2-3. The margins of the lemmas are somewhat inrolled, so that the spikelet appears to have a deep groove along the center. The above



FIG. 27. *Bambusa vulgaris*. A, pseudospikelet containing several spikelets; B, foliage-bearing vegetative branchlet; C, portion of inflorescence with pseudospikelets.

description was compiled from that of Gamble and limited spikelet material available to me.

This species is frequently cultivated in Central America for ornament and construction materials. We have seen no blooming Central American specimens in the field or herbarium, and literature records indicate that blooming is very rare. Nearly all clumps that I have seen have yellow and green striped internodes. This form has variously been designated as var. *striata* Gamble or as horticultural form *vittata* A. & C. Riv. The native home of this Old World species is uncertain, but it is widely cultivated in both hemispheres.

BOTHRIOCHLOA O. Kuntze

REFERENCES: S. T. Blake, Taxonomic and nomenclatural studies in the Gramineae, No. 1, Proc. Roy. Soc. Queensland 80:55-84. 1969. F. Gould, New North American Andropogons of subgenus *Amphilophis* and a key to those species occurring in the United States, Madroño 14:18-29. 1957.

Caespitose or stoloniferous grasses; inflorescence of several rames borne on a central rachis; rames consisting of several to many spikelet pairs borne on a slender rachis that disarticulates at the apex of each internode, spikelet pairs falling as units with the attached rachis internode. One spikelet of each pair sessile, awned, perfect-flowered and one pedicellate, awnless, staminate or sterile; some basal pairs of spikelets alike and awnless, staminate or sterile; rachis internodes and pedicels with thickened margins and a very thin, translucent line down the middle. Spikelets dorsally compressed, the sessile ones with a flattened, many-nerved first glume whose edges are inrolled over the margins of the second and slightly keeled on the upper half; second glume slightly longer than the first, acuminate, 3-nerved, convex on the back; glumes completely enclosing and concealing the floret. Awned spikelets: florets 2, the lower represented by a thin, nearly nerveless translucent scale, the second reduced to the flattened base of the awn; lodicules 2, truncate; awn twisted and geniculate. Pedicellate spikelets: dorsally flattened, biconvex, similar to the sessile spikelets but awnless; a single lemma present; no flower present.

Bothriochloa is primarily a genus of the Old World tropics, with a few species native in warmer parts of the Americas. It is similar to *Andropogon*, from which it differs in the thin line down the middle of the rachis joints and pedicels, and in the fertile lemma, which is reduced to an awn, lacking a membranaceous body. (Panicoideae: Andropogoneae.)

***Bothriochloa pertusa* (L.) Camus**, Ann. Soc. Linn. Lyon n. ser. 76:164. 1931. *Holcus pertusus* L., Mant. Pl. 2:301. 1771. *Andropogon pertusus* (L.) Willd., Sp. Pl. 922. 1806. Figure 28.



FIG. 28. *Bothriochloa pertusa*. A, inflorescence and culm; B, portion of a rame, the sessile spikelets with pits in the first glumes.

Plants sprawling, weak-stemmed, rooting at the lower nodes; duration indefinite; culms 30-100 cm. long, freely branching, glabrous except upwardly bearded at the nodes, hollow; sheaths keeled, more or less hirsute; ligule a ciliate membrane, 0.7-1.2 mm. long; leaf blades 3-4 mm. wide, with scattered elongate papillose-based hairs on the margins and above the ligule. Peduncle exerted up to 12 cm. from the nearly glabrous, bladeless, upper sheath, glabrous, slightly bearded at the apex; inflorescences terminal on the main culms and on leafy branches, 3-5 cm. long, fan-shaped, often purplish. Rames several, racemosely arranged along a short rachis, ascending. Sessile spikelets awned, 3.2-4.0 mm. long, lanceolate; first glume ca. 9-nerved, tapering to a narrow truncate apex, with a prominent circular pit near the middle; second glume slightly longer, tapering to an acuminate apex, its margins somewhat ciliate above; lower lemma oblong, 2.5-2.7 mm. long; upper lemma reduced to the awn, which has a flattened whitish base; anthers 3, yellow, 1.0-1.8 mm. long. Chromosome number $n = 20$ from this specimen.

Weed; dock area, Quepos. January.

Introduced from the Old World; southern United States and Mexico; West Indies.

BOUTELOUA Lagasca

REFERENCES: F. W. Gould, Taxonomy of the *Bouteloua repens* complex, *Brittonia* 21:261-274. 1969. F. W. Gould & Z. J. Kapadia, Biosystematic studies in the *Bouteloua curtipendula* complex, *Brittonia* 16:182-207. 1964. David Griffiths, The grama grasses: *Bouteloua* and related genera, *Contr. U.S. Natl. Herb.* 14:343-428 + XI. 1912.

Annual or perennial caespitose or rhizomatous grasses; inflorescence a raceme of 1-many unilateral spikes; spikelets usually 3-many per spike, borne in 2 rows on the lower side of the rachis, usually densely crowded; disarticulation above the glumes or (in all our species) at the base of the individual spikes, which fall as units; glumes 1-nerved, unequal, shorter than the florets; spikelets with one fertile floret at the base and one or two variously modified or ornamented sterile florets above it; lemma 3-nerved, the nerves often excurrent as awns.

Bouteloua is an American genus of about 40 species, native to warm or arid portions of North, Central, and South America. In the Central American flora, its closest relatives are *Pentarraphis*, *Aegopogon*, *Chloris*, *Eustachys*, and *Gymnopogon*. (Chloridoideae: Chlorideae.)

KEY TO SPECIES OF *Bouteloua*

- 1a. Spikes 20 or more per inflorescence, drooping 2
- 1b. Spikes 10 or fewer per inflorescence, usually ascending or erect 3
- 2a. Spikelets 2-4 per spike; anthers ca. 1.5 mm. long; weak prostrate annual
B. disticha
- 2b. Spikelets 8-11 per spike; anthers ca. 3 mm. long; tall erect perennial *B. media*
- 3a. Rachis and glumes heavily bearded; awns short and inconspicuous
B. chondrosioides

- 3b. Rachis and glumes glabrous or short ciliate; awns usually conspicuous 4
- 4a. Spikes slender, successive spikelets separated by about half their length; rudimentary floret sterile, reduced to 3 stiff awns attached to a small rigid cylindrical lemma body *B. americana*
- 4b. Spikes not slender, the spikelets crowded; rudimentary floret with a well developed flat lemma 5
- 5a. Awns of rudimentary floret 12-17 mm. long; spikelets 3-4 per spike, crowded near the base of the rachis; plants annual *B. alamosana*
- 5b. Awns of rudimentary floret 2-10 mm. long; spikelets 4-8 per spike, distributed along the lower half of the rachis; plants perennial *B. repens*

Bouteloua alamosana Vasey, Contr. U.S. Natl. Herb. 1:115. 1891. Figure 29.

Weak, sprawling annual; culms 20-80 cm. long, branching freely from the base and the lower culm nodes, ca. 1 mm. thick, solid and pithy, glabrous; sheaths shorter than the internodes, glabrous to papillose-hirsute; ligule a minute membranous rim, ciliolate, 0.2-0.3 mm. long; blades 3-7 cm. long, 1.5-3.0 mm. wide, more or less papillose-hirsute on both surfaces, especially near the base; peduncle 3-25 cm. long; inflorescences terminal and axillary; inflorescence a unilateral raceme of 4-9 ascending or spreading unilateral spikes; rachis of spikes strongly hispid-bearded, flat, ca. 10 mm. long, prolonged as a thickish stipe ca. 1 mm. long below the spikelets. Spikelets usually 3-4, crowded near the base of the rachis, ca. 8 mm. long (excluding the awns), often purplish; glumes subequal, 5-7 mm. long, 1-nerved, linear to lanceolate, strongly short-hispid on the keels; lower floret 6.0-6.5 mm. long; lemma glabrous, lanceolate, the 3 nerves extending as short awns from the upper quarter of the body; palea 7-8 mm. long, longer than the lemma, firm, oblong, bidentate, pubescent between the keels, the margins broad, overlapping near the apex; anthers 1.1-1.3 mm. long; second floret staminate; lemma 5.5-6.0 mm. long, wider than the first lemma; awns subequal, 12-17 mm. long, flat, rigid, scabrous, the lateral ones arising about the middle of the lemma, the middle one between 2 apical teeth; palea ca. 5.5 mm., bidentate. Chromosome number $n = 30$ from a Honduran specimen.

This species has been found only near Liberia, along the Carretera Interamericana, at Puntarenas, and on the bluffs at Playas del Coco. Blooming in November and December; elevations from sea level to 100 m. Mexico to northern Guanacaste, along the Pacific slope.

Bouteloua americana (L.) Scribn., Proc. Acad. Nat. Sci. Philadelphia 43:306. 1891. *Aristida americana* L., Syst. Nat. ed. 10; 2:879. 1759. Figure 30.

Duration indefinite; culms prostrate to ascending, usually 25-50 (100) cm. long, freely branching; prophyllum 25-35 mm. long, bidentate at tip; culms 1.0-1.5 mm. thick, solid, pithy, glabrous; leaves numerous, the sheaths shorter than the internodes, glabrous; ligule 0.5-0.8 mm. long, a strongly ciliate membrane; leaf blades 4-11 cm. long, 2-4 mm. wide, pustulose-ciliate on the margins near the base and sometimes on the upper surface. Peduncle usually 3-5 cm. long; inflorescence 6-12 cm. long, of 5-9 slender, ascending unilateral spikes borne racemously along a slender rachis, naked at the base for 1-2 mm., the rachis 2-4 cm. long, triquetrous, the 5-10 spikelets somewhat remote, appressed,

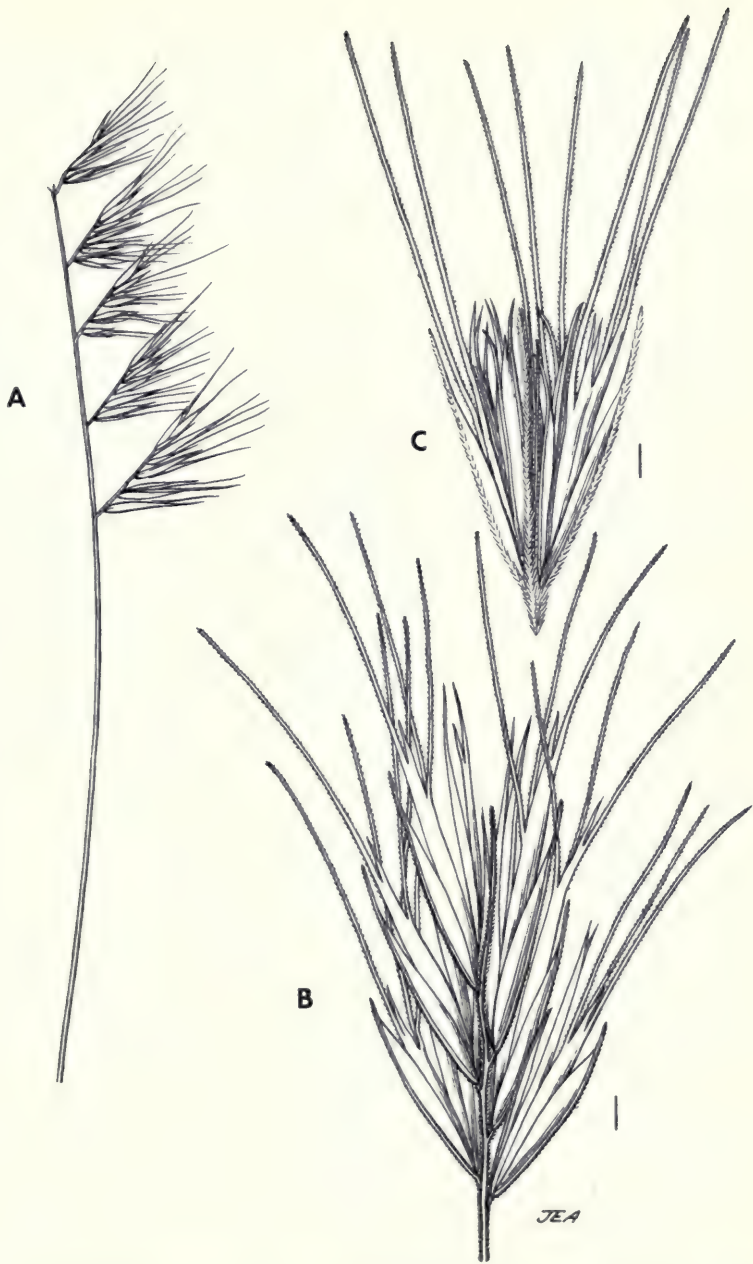


FIG 29. *Bouteloua* species. *B. repens*: A, inflorescence; B, single spike, seen from beneath; *B. alamosana*: C, single spike.

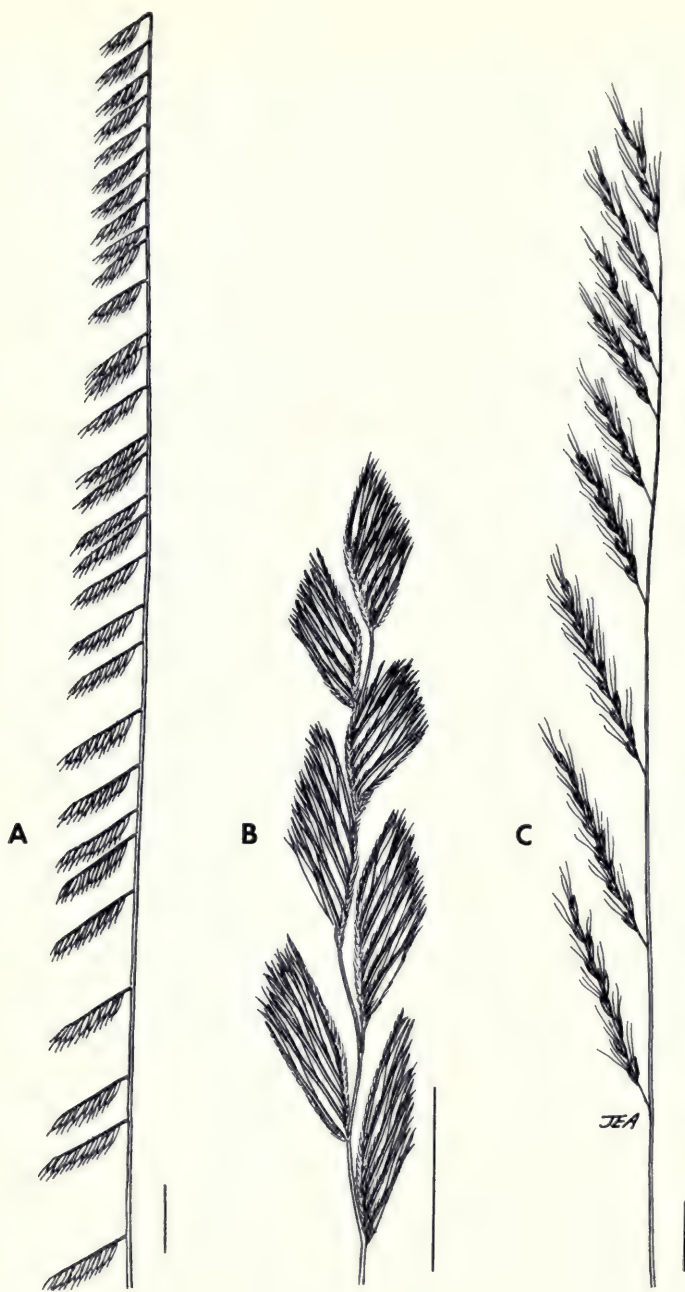


FIG. 30. *Bouteloua* species. A, *B. media*; B, *B. chondrosioides*, C, *B. americana*.

distant by one-half to three-fourths of their length, 5.5-8.0 mm. long, excluding the awn of the rudiment; disarticulation at the base of the individual spike, or sometimes above the glumes, the 2 florets falling together; glumes subequal, 3.5-4.5 mm. long, 1-nerved, narrowly ovate, acute; florets 2, the lower lemma with an oblique bearded callus, otherwise glabrous, lanceolate, 3-nerved, the nerves excurrent as short awns, the central one ca. 2 mm. long; lemma and palea firm, shining, purplish; palea bidentate at the tip; rachilla segment slender; rudimentary floret reduced to 3 stiff flat scabrid awns jointed onto a very short firm cylindrical lemma body; palea ca. 1.0-1.5 mm. long; rachilla prolonged beyond the palea as a minute bristle. Chromosome number $n = 20$ from Costa Rican specimens.

This species has been collected in Costa Rica only in the vicinity of Puntarenas, from sea level to 125 m. elevation. It grows along the Carretera Interamericana south of the Puntarenas junction. October. Bahamas and Caribbean Islands; Guatemala to Panama, Venezuela, and Brazil.

Bouteloua chondrosioides (H.B.K.) Benth. ex S. Wats., Proc. Amer. Acad. Sci. 18:179. 1883. *Dinebra chondrosioides* H.B.K., Nov. Gen. & Sp. 1:173. 1816. Figure 30.

Erect caespitose perennial; culm 10-50 cm. tall, ca. 1 mm. thick, ridged, glabrous, solid, pithy, arising from a knotty crown; nodes glabrous; foliage mostly aggregated on the lower half of the culm; sheaths shorter than the internodes, glabrous, glaucous, ridged, 1-10 cm. long, the upper ones much reduced, 1.5-3.0 mm. wide, somewhat pustulose-hispid, especially on the margins; peduncle exerted 2-7 cm.; inflorescence 3-7 cm. long, a raceme of 3-8 ascending or appressed thick, rhombic spikes; individual spikes 8-10 mm. long, purplish, heavily bearded at the base and along the rachis; spikelets 9-11 per spike, densely crowded; rachis usually extended as a naked point up to 5 mm. beyond the spikelets. Spikelets 7.0-7.5 mm. long; first glume acicular, 2.5-4.5 mm. long, hispid along the midrib; second glume 4.5-6.5 mm. long, narrowly lanceolate, with a very broad, flat midrib which is heavily hispid; lower lemma 4.7-6.2 mm. long, narrowly ovate, hispid on the upper half, especially along the nerves; awns 3, short, at the tip of the lemma; palea longer than the lemma, 5.0-7.2 mm. long, somewhat hispid on the upper half; anthers yellow, 2.8-3.5 mm. long; second floret rudimentary, composed of 3 awns 2-7 mm. long, the central one sometimes with a membranaceous margin. Chromosome numbers $n = 10, 20$.

Western Texas and southern Arizona to Guanacaste. Reported from the Nicoya Peninsula by Hitchcock.

Bouteloua disticha (H.B.K.) Benth., J. Linn. Soc. Bot. 19:105. 1881. *Polydon distichum* H.B.K., Nov. Gen. & Sp. 1:175. 1816. *Bouteloua pilosa* (Hook. f.) Benth. ex S. Wats., Proc. Amer. Acad. Sci. 18:179. 1883.

Annual; plants decumbent to prostrate, the culms rooting at the lower nodes; branching abundant; prophyllum 15-35 mm. long, the keels ciliate; culms glabrous, ca. 1 mm. thick, solid, pithy; sheaths much shorter than the elongated internodes, glabrous to papillose-hirsute; dewlap prominent; auricular hairs sometimes present; ligule a ciliate

membrane, 0.2-0.5 mm. long; leaf blades 6-13 cm. long, 2-5 mm. wide, glabrous to papillose-hirsute on both surfaces and the margins; peduncle slender, glabrous, exserted 4-22 cm.; inflorescence solitary, terminal, unilateral, 8-15 cm. long, bearing 30-50 pendant spikes on minute branchlets; individual spikes unilateral, the 2-4 spikelets borne on the underside of the stiff flattened rachis near its base, occasionally 1 or 2 of them reduced or sterile; rachis of spikes 4.0-5.5 mm. long, often bidentate at the tip. Spikelets narrow, 5.5-7.5 mm. long, excluding the awn of the rudiment; first glume acicular, 1-nerved, 3.8-5.5 mm. long; second glume lanceolate, 1-nerved, 5.5-7.0 mm. long; lemma of lower floret glabrous, lanceolate, 5-7 mm. long, the apex trifid, with 3 short awns; palea bifid, 5-6 mm. long, glabrous; anthers ca. 1.5 mm. long, orange, second floret sterile, with a very short palea, the lemma from very small to larger than the fertile floret, deeply 3-lobed, the lateral nerves extending into awns 4-8 mm. long, the midrib extending into an awn 7-10 mm. long, arising between 2 hyaline teeth; rachilla not prolonged beyond the second floret. Chromosome number $n = 20$ from Costa Rican specimens.

Roadsides and weedy open areas, sea level to 1,200 m. elevation; Pacific slope, from northern Guanacaste to Atenas. October to February. Southern Mexico to Ecuador, Peru, and the Galapagos Islands.

Bouteloua media (Fourn.) Gould & Kapadia, *Brittonia* 16:196. 1964.
Atheropogon medius Fourn., *Mex. Pl.* 2:139. 1881. Figure 30.

Tall, leafy perennial, in dense clumps; culms erect, 70-200 cm. tall, usually unbranched or sometimes with an axillary inflorescence below the terminal one; culms solid, pithy, scabrid or papillose-hirsute; sheaths mostly overlapping, scabrous, sometimes papillose-hirsute; ligule membranaceous, ciliate, 0.5-0.7 mm. long; leaf blades up to 30 cm. or more long, 4-6 mm. wide, scabrous, also papillose-hirsute on auricles, upper surface above the base, and margins; peduncle scabrous, ridged; terminal inflorescence a slender raceme 20-25 cm. long, of up to 40 drooping unilateral spikes borne on slender, lax, scabrous branchlets 2-3 mm. long; individual spikes 1-2 cm. long, tending to be approximate in pairs. Spikelets usually 8-11 per spike, often some of the basal ones abortive, sessile in 2 rows on the lower side of the flat scabrous rachis; rachis 8-10 mm. long, sometimes extended beyond the spikelets as a naked point. Spikelets 5-6 mm. long, excluding the awns; first glume 4.0-4.5 mm. long, linear, awn-tipped, second glume 4.8-5.3 mm. long, lanceolate, acute; lemma of lower floret 5.0-5.5 mm. long, lanceolate, scabrid in lines, the nerves extended into 3 short awns near the tip; palea 5.2-5.5 mm. long; anthers 2.8-3.5 mm. long, yellow to orange; rudimentary florets 1 or 2, the first with a lemma ca. 3 mm. long, bifid to the base, the lateral awns 4-5 mm. long, the central one 5-9 mm. long, palea absent; second rudimentary floret, when present, much smaller. Our single chromosome count of this species was aneuploid, with $2n = 27$. The only previous count was diploid, $2n = 20$.

Upper grassy slopes of bluffs, south end of Playas del Coco, Guanacaste; elevation ca. 100 m. July to December. This is the southern limit of the range of this species, which extends southward from southern Mexico.

Bouteloua repens (H.B.K.) Scribn. & Merr., *Bull. U.S.D.A. Div. Agrost.* 24:26. 1901. *Dinebra repens* H.B.K., *Nov. Gen. & Sp.* 1:172.

1816. *Bouteloua filiformis* (Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14:413. 1912. *B. pubescens* Pilger, Verh. Bot. Vereins Prov. Brandenburg 51:193. 1909. *B. heterostega* (Trin.) Griffiths, Contr. U.S. Natl. Herb. 14:414. 1912. Figure 29.

Perennial; culms 15-65 cm. long, glabrous, solid, pithy, prostrate to ascending, the lower nodes sometimes rooting; sheaths glabrous to softly pubescent; auricular hairs present; ligule a minute ciliate rim, 0.2-0.3 mm. long; blades 5-20 cm. long, 1-4 mm. wide, papillose-ciliate along the margins near the base, sometimes puberulent or pubescent on one or both surfaces; peduncle stiff, 4-10 cm. long; inflorescence 4-14 cm. long, a unilateral raceme of usually 7-9 unilateral spikes, these deciduous as wholes; individual spikes with a minute ciliate stipe at the base, bearing usually 4-8 spikelets crowded in 2 rows on the basal 6-10 mm. of the rachis, which extends above the spikelets as a naked stipe 4-6 mm. long. First glume 4-6 mm. long, 1-nerved, ovate, scabrous on the keel; second glume similar, 4-9 mm. long; lemma of lower floret 5.0-7.5 mm. long, lanceolate, glabrous; lateral nerves excurrent as short awns ca. 1 mm. long near the tip, the central awn slightly longer; palea 6-8 mm. long, glabrous or cottony between the keels; anthers 3.5-5.5 mm. long, yellow or orange, second floret usually staminate, its lemma 5.5-7.0 mm. long, ovate, 3-awned, the lateral nerves excurrent as awns about halfway up the lemma, the midnerve awned between 2 teeth; awns about equal, 2-10 mm. long; anthers usually present, smaller than those of the lower floret; palea 4-7 mm. long, glabrous or cottony between the keels; rachilla prolonged beyond the second floret as a short bristle. Chromosome numbers $n = 10, 20, 30, 21, 22$, ca. 45, 46.

Savannas, roadsides, often on volcanic ash; from sea level to 100 m. Guanacaste, S to the area of Puntarenas. July to December. Southern Arizona and Texas to Venezuela and Colombia; Caribbean Islands.

BRACHIARIA Grisebach

REFERENCE: S. T. Blake, New criteria for distinguishing genera allied to *Panicum* (Gramineae), Proc. Roy. Soc. Queensland 70:15-19. 1958.

Plants annual or perennial, the culms often decumbent and rooting. Inflorescence a panicle of several-many slender racemes borne racemosely along a central rachis; racemes rarely secondarily branched and bearing short fascicles of spikelets; spikelets usually solitary or paired, short-pedicellate along the rachis, their first glumes turned toward the midrib of the rachis. Spikelets disarticulating below the glumes, dorsally compressed, ovate-obovate, plano-convex or biconvex; first glume short, 1-many-nerved; second glume and lower (sterile) lemma subequal, as long as the spikelet, 5-9-nerved; lower lemma with a well-developed palea and usually a staminate flower; upper (fertile) floret shorter than the second glume and sterile lemma, cartilaginous or rigid, rugulose or striate, the lemma elliptical or obovate, its margins incurved over the keels of the equal palea of similar texture; palea sometimes convex; lodicules 2, truncate; stamens 3; style branches separate; caryopsis elliptical, dorsally flattened, with a large embryo.

Brachiaria is a large genus of grasses of warm climates in both the eastern and western hemispheres, most numerous in Africa. It is most

closely related to *Eriochloa*, *Setaria*, *Paspalidium*, and *Urochloa*. It is distinguished mostly by the simple panicle branches with the spikelets usually in orderly rows along them, the first glumes turned toward the midrib. Blake has indicated that the presence of a prominent "rupture line" at the base of the fertile lemma distinguishes this genus from *Panicum*, although this feature occurs throughout the Paniceae. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Brachiaria*

- 1a. Spikelets 4.5 mm. or more long 2
- 1b. Spikelets 4.0 mm. or less long 3
 - 2a. Rachis of racemes prominently papillose-ciliate; spikelets hairy near the tip
B. brizantha
 - 2b. Rachis of racemes not ciliate; spikelets glabrous *B. plantaginea*
- 3a. Spikelets pubescent with papillose-based hairs *B. mollis*
- 3b. Spikelets glabrous 4
 - 4a. Spikelets 3 mm. or less long, dull yellow, brown, or deep purple; racemes numerous *B. fasciculata*
 - 4b. Spikelets over 3.2 mm. long, green or marked with purple; racemes few to many 5
- 5a. First glume 9-nerved; nodes glabrous or nearly so; racemes 3-4 *B. distachya*
- 5b. First glume 1-nerved; nodes conspicuously retrorsely hirsute; racemes numerous *B. mutica*

Brachiaria brizantha (Hochst.) Stapf, Fl. Trop. Africa 9:531. 1919.
Panicum brizanthum Hochst. ex Rich., Tent. Fl. Abyss. 2:363. 1851.

Erect perennial, to 2 m. tall; culms branching occasionally from the middle nodes, internodes up to 3 mm. thick, hollow, thick-walled, smooth and glabrous or somewhat hairy; sheaths about equal to the internodes, glabrous; ligule a short, stiffly ciliate membrane, in total 1.2-2.0 mm. long; leaf blades 15-35 cm. long, 7-18 mm. wide, glabrous or pubescent, the margins scabrous, with thick, whitish sclerenchyma bands. Inflorescence of 2-many remote arching racemes, these one-sided, 6-12 cm. long, slender, the spikelets apparently 1-rowed; rachis flat, less than 1 mm. wide, papillose-ciliate on the edges. Spikelets 5.0-5.8 mm. long, obovate 2.5:1, with a short basal stipe ca. 0.5 mm. long, a similar internode between the first and second glumes; first glume broadly deltoid with overlapping edges, 7-9-nerved; second glume and lower (sterile) lemma equal, about as long as the spikelet; second glume 5-7-nerved; lower lemma 5-nerved, with a large palea and sometimes 3 stamens; both second glume and lower lemma sparsely papillose-hirsute near the tip and sometimes purple-marked; upper floret 4.3-4.6 mm. long, rigid, finely striate or minutely rugulose; palea equal to the lemma; lodicules 2, truncate; anthers 3, 2.7 mm. long, brown; styles separate; stigmas purple.

Cultivated in the grass garden at the CATIE at Turrialba and at Guapiles; possibly in commercial production. Native to tropical Africa.

Brachiaria distachya (L.) Stapf, Fl. Trop. Africa 565. 1919.
Panicum distachyon L., Mant. Alt. 183. 1771. *Panicum subquad-*

riparum Trin., Gram. Pan. 145. 1826; *Brachiaria subquadripa* (Trin.) Hitchc., Lingnan Sci. J. 7:214. 1931. Figure 32.

Duration indefinite; plants sprawling, the culm bases long decumbent and rooting at the nodes, the erect portions 20-30 cm. long; branching abundant, older culms bearing fascicles of branches; culms solid, glabrous, or with scattered papillose-hispid hairs; nodes glabrous or bearded below the sheath margin; sheaths keeled, glabrous or with scattered hispid hairs, the overlapping margin densely papillose-ciliate; ligule a short membrane, long-ciliate, in total 0.5-1.3 mm. long; leaf blades flat, 3-9 cm. long, 4-8 mm. wide, the edges thickened, scabrous, glabrous or with scattered papillose-hispid hairs on the basal margins and on the surfaces. Peduncle included or exerted up to 15 cm.; inflorescences numerous, terminal or axillary, 4-8 cm. long, composed of usually 3 short, ascending, racemosely arranged, one-sided racemes, each 1.5-3.5 cm. long. Spikelets borne in 2 rows on the lower side of a winged, triquetrous rachis ca. 1 mm. wide; pedicels 0.5-0.7 mm. long, angular. Spikelets glabrous, 3.5-3.8 mm. long, ovate to obovate, first glume 1.6-1.8 mm. long, 9-nerved, transversely depressed ovate, blunt, enveloping the base of the spikelet, the margins meeting; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 7-nerved; sterile lemma 5-nerved, inclosing an oblong palea 2.7-2.8 mm. long; upper (fertile) lemma rigid, elliptic-obovate 2:1, 2.7-2.8 mm. long, rugulose, with an areole near the base; margins thick, barely covering the keels of the palea of similar texture and length; anthers 1.3 mm. long; stigmas purple; caryopsis elliptical 2:1, 2.0-2.1 mm. long, whitish; embryo large. Chromosome number $n = 36$.

Elsewhere in America, it is known only from Veracruz and Progreso, Mexico. Pacific Islands and southeastern Asia; tropical Africa. Known in Costa Rica only by the following specimen: Puntarenas, Esterillos Este, sandy field behind beach, P. & D. 11687, 28 January 1969.

Brachiaria fasciculata (Sw.) Parodi, Darwiniana 15:96. 1969. *Panicum fasciculatum* Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Annual; plants tufted, erect, or the lower nodes of the culms decumbent and rooting; culms 10-100 cm. long, branching from the lower and middle nodes; prophylla prominent, up to 5.5 cm. long; internodes up to 2 mm. thick, hollow, thick-walled, more or less papillose-hispid, especially toward the apex; sheaths about as long as the internodes, keeled near the apex, more or less papillose-hispid, the overlapping margin strongly papillose-ciliate; ligule a short membrane, densely ciliate, in total 0.3-2.3 mm. long; leaf blades flat, rounded to the base, 4-30 cm. long, 7-18 mm. wide, more or less papillose-pilose or hispid on both surfaces. Inflorescences terminal on the culm or on leafy branches; peduncle exerted up to 15 cm.; panicles 3.5-15 cm. long, ovoid, 1-9 cm. wide, composed of numerous ascending simple branches racemosely arranged along a grooved central rachis, 1-several per node; spikelets solitary, short-pedicellate in 2 rows along the lower sides of the branches, or more commonly in small clusters of 2-5 borne along the lower sides of the primary branches; rachis and branches angular, scabrous, sometimes papillose-pilose. Spikelets turgid, biconvex, obovate 5:3, bluntly mucronate, dull yellow or deep purple, 2.3-3.0 mm. long; first glume transversely ovate, acute, its edges overlapping; nerves 3-5; second glume and lower (sterile) lemma equal, as long as the

spikelet; second glume 9-nerved, often with small cross-veins near the apex; lower lemma similar, 7-nerved; upper (fertile) floret 1.9-2.5 mm. long, elliptical-obovate, acute 4:3; lemma rigid, strongly rugose, with a conspicuous basal areole; margins thick, clasping the keels of the similar convex palea of equal length. Chromosome number $n = 9$ from Costa Rican specimens.

Open disturbed areas, pastures, roadsides, river banks; low elevations on the Pacific slope; common in Guanacaste, usually below 600 m. elevation; western parts of the Meseta Central; Turrialba; Limón area; Guapiles. Blooming June to February. Extreme southern United States to Brazil and Ecuador; West Indies.

This species has been included in the genus *Panicum* in most American publications. Recent authors have assigned it to *Brachiaria*, although the placement of the spikelets is not as regular as in other species. The current placement is based principally on the rugose character of the fertile lemma and the presence of an areole (germination lid) at its base, along with the rather simple panicle branches.

***Brachiaria mollis* (Sw.) Parodi, Darwiniana 15:100. 1969. *Panicum molle* Swartz, Prodr. Veg. Ind. Occ. 22. 1788.**

Annual; plants erect to sprawling, the bases sometimes long decumbent and rooting at the nodes; branching from the lower and middle nodes; prophylla up to 2.5 cm. long; culm internodes up to 2.5 mm. thick, hollow, thick-walled, more or less papillose-pilose or puberulent; nodes bearded; leaf sheaths about as long as the internodes, papillose-pilose or puberulent; ligule a ciliate membrane, 0.5-1.0 mm. long; leaf blades broad-based, 6-14 cm. long, 5-15 mm. wide, flat, papillose-pilose, or velvety. Peduncle included or exerted up to 13 cm; inflorescences terminal on leafy branches, numerous, 3-7 cm. long, 1-3 cm. wide, consisting of up to 8 short, ascending, 1-sided racemes, each 1-3 cm. long; rachis and branches puberulent or pilose, the short pedicels sometimes bearing glassy hispid hairs; spikelets solitary or paired along the lower sides of the rachis, the first glumes turned toward the center of the rachis. Spikelets 3.4-4.0 mm. long, villous, obovate 2:1, apiculate, biconvex; first glume 2.0-2.7 mm. long, 5-nerved, ovate, acute; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 7-nerved; lower lemma similar, but 5-nerved; its palea 2.7-3.0 mm. long; upper (fertile) floret 2.6-3.1 mm. long, rigid, obovate 5:3, rugulose, apiculate, its margins inrolled over the margins of a similar palea; lodicules 2, fleshy, truncate; anthers 3, tan, 1.0-1.1 mm. long; styles separate; stigmas purple; caryopsis white, 2 mm. long, elliptical 4:3; embryo three-fourths as long as the grain. Chromosome number $n = 27$ from Costa Rican specimens.

Occasional, dry roadsides and savannas, low elevations, northern Guanacaste; Puntarenas, Atenas. June to November. Mexico and the West Indies to Argentina.

This species has generally been included in the genus *Panicum* in American publications, but has been transferred to *Brachiaria* because of the form of the inflorescence and the rugose floret.

Brachiaria mutica (Forsk.) Stapf, Fl. Trop. Africa 9:526. 1919. *Panicum muticum* Forsk., Fl. Aegypt.-Arab. 20. 1775. *Panicum purpurascens* Raddi, Agrost. Bras. 47. 1823. Figure 31.

Sprawling perennial, the culms becoming long-decumbent and rooting at the lower nodes, up to 6 m. long, branching from lower and middle nodes; internodes glabrous, hollow, thick-walled; nodes prominent, retrorsely papillose-hirsute; sheaths longer than the internodes, more or less papillose-hirsute to nearly glabrous; ligule a very short membrane, densely white ciliate, in total 1.5-1.8 mm. long; dewlap and collar finely velvety; blades flat, up to 25 cm. long and 15 mm. wide, mostly glabrous or with a few hairs near the base; midrib broad and white above near the base; margins thick, purple, scabrous. Inflorescences terminal on leafy branches, up to 20 cm. long, of several to many solitary or clustered ascending racemes borne along a central rachis; racemes 1-7 cm. long; spikelets solitary, paired, or in small clusters along the lower sides of the triquetrous rachis; bases of branches velvety; rachis up to 1 mm. wide, the angles scabrous and bearing scattered papillose hairs. Spikelets 3.2-3.4 mm. long, ovate 3:2, acute, often purple, glabrous; first glume 0.8-1.2 mm. long, deltoid, 1-nerved; second glume and lower lemma equal, about as long as the spikelet; second glume 5-7-nerved; lower lemma similar, 5-nerved, inclosing a large palea that frequently protrudes between the lemma and second glume at the tip; stamens 3; upper (fertile) floret 2.1-2.5 mm. long, elliptic-obovate, striate or rugulose; palea similar, flat; lodicules 2, truncate; anthers 3, 1.3-1.5 mm. long, yellow or purple; style branches separate; stigmas purple.

Cultivated for forage, especially on the Caribbean slope and occurring in the wild, in wet sites or water; elevations up to 1,600 m. This species has had an involved nomenclatural and migrational history. It has been known as *Panicum purpurascens* in American literature, but is now usually referred to the genus *Brachiaria*. It is probably of African ancestry, but has long been resident in the American tropics. The plants are very similar to those of *Eriochloa polystachya* in vegetative and flowering structure and may grow intermixed with the latter. Common name: *Zacate pará*.

Brachiaria plantaginea (Link) Hitchc., Contr. U.S. Natl. Herb. 12:212. 1909. *Panicum plantagineum* Link, Hort. Berol. 1:206. 1827. Figure 32.

Duration indefinite; plants sprawling, the culms decumbent and rooting at the lower nodes, branching freely from the prostrate portions, up to 1 m. long; culms glabrous, solid or the decumbent parts with a small lumen; nodes glabrous, not prominent; leaf sheaths about as long as the internodes, keeled, glabrous but papillose-ciliate on the overlapping edge; ligule a very short membrane, ciliate with a dense row of stiff hairs, in total 0.5-1.5 mm. long; leaf blades flat, glabrous except for a few long cilia at the base, 4-21 cm. long, 6-13 mm. wide, the margins thickened, scabrous; midrib prominent beneath. Inflorescences terminal on leafy ascending branches; peduncle included or exserted up to 8 cm.; inflorescence of 4-5 distant ascending racemes, borne racemously along a flattened, grooved rachis; racemes 2-11 cm. long, slender, bearing spikelets nearly to the puberulent basal pulvinus; rachis of racemes prominently 3-winged, 1.1-1.2



FIG. 31. *Brachiaria mutica*. Plant, inflorescence, fertile floret, and two views of a spikelet.

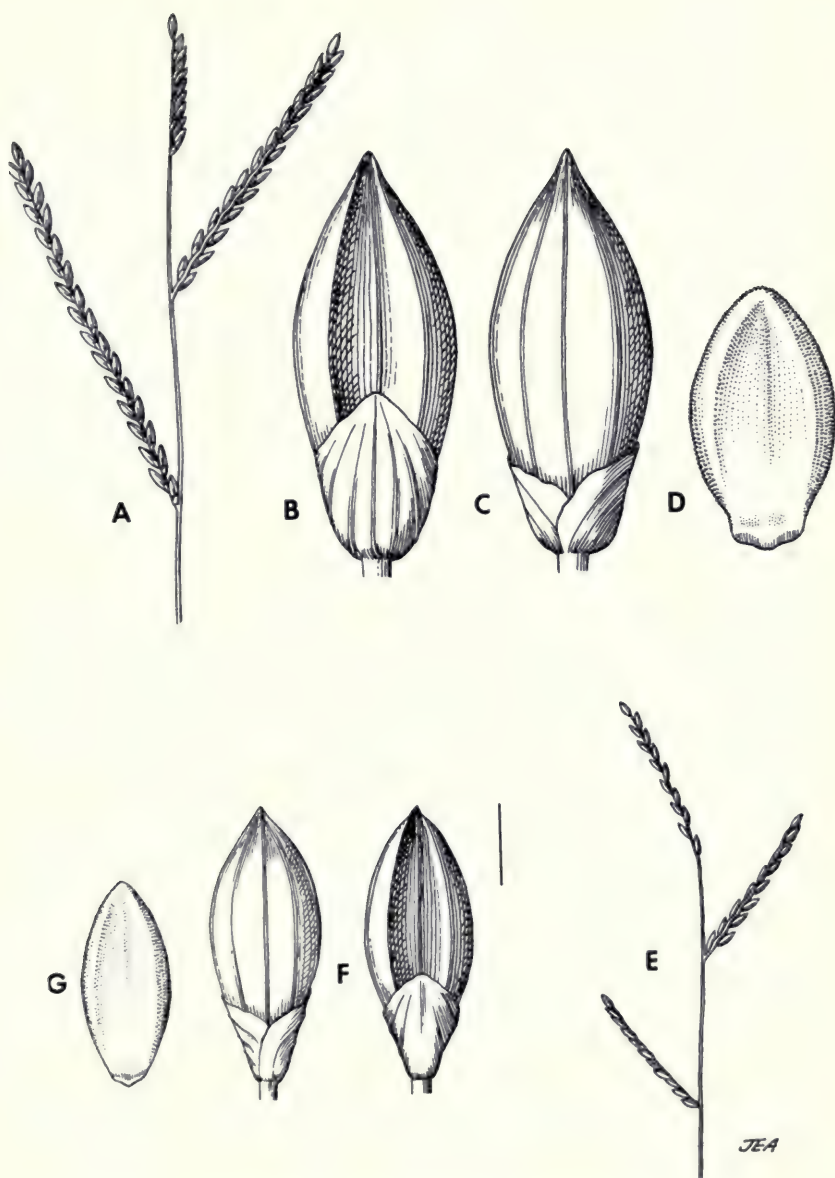


FIG. 32. *Brachiaria* species. *B. plantaginea*: A, inflorescence; B, C, two views of a spikelet; D, rugose fertile lemma; *B. distachya*: E, inflorescence; F, two views of a spikelet; G, fertile lemma.

mm. wide, the angles scabrous; spikelets borne alternately in 2 rows on opposite sides of the winged midrib of the rachis, their pedicels up to 1 mm. long; spikelets oriented with their first glumes toward the midrib. Spikelets 4.7-5.2 mm. long, ovate-obovate, 2.5-3:1, acute, glabrous; first glume transversely broadly ovate, 5:7, blunt, clasping the base of the spikelet, the margins in contact with each other, nerves 9-11; second glume and lower (sterile) lemma equal, as long as the spikelet, concealing the shorter fertile floret; second glume 7-nerved; lower lemma 5-nerved, concealing a membranaceous palea of equal length; upper (fertile) lemma 3.2-3.6 mm. long, elliptical 7:4, faintly 5-nerved, minutely rugulose, rigid, with a horseshoe-shaped areole near the base; middle of lemma flattened or depressed; palea of equal length, its keels and margins covered by the inflexed thick margins of the lemma; anthers 3, yellow, 0.7-1.0 mm. long; stigmas purple; flowers probably cleistogamous; caryopsis flattened, elliptical, whitish, 2.2 mm. long. Chromosome number $n = 18$ from a Costa Rican specimen.

Roadsides, cafetales, weedy pastures and savannas, up to 1,500 m. elevation; Meseta Central, Cartago, Cañas area. Blooming yearlong. Mexico to Brazil and Bolivia.

This species is common around San José, and Tonduz noted on a herbarium specimen that it was once cultivated in an experimental field in Guadalupe. He gives the common name as *arrochillo*.

BRACHYPODIUM Beauvois

Caespitose perennial grasses; culms becoming much-branched; inflorescence a slender terminal raceme of a few erect spikelets borne on a slender axis. Spikelets several-many-flowered, at first cylindrical, becoming laterally compressed; glumes and lemmas rounded on the back, not keeled; glumes somewhat unequal, the first slightly shorter than the second, both with about 7 nerves; disarticulation above the glumes and between the florets; lemmas 7-nerved, tapering into a short stiff awn; paleas slightly shorter than the lemmas, their keels pectinate-ciliate.

A small genus of about 15 species, mostly of the temperate and tropical regions of the eastern hemisphere. Three species have been credited to Mexico and Central America, but probably all represent phases of one. The genus is easily confused with *Agropyron*, but species of the latter have sessile spikelets and unbranched culms, whereas *Brachypodium* plants have the spikelets borne on short erect pedicels, and the plants become much-branched with age. (Pooideae: Poeae?)

Brachypodium mexicanum (Roem. & Schult.) Link, Hort. Berol. 1:41. 1827. *Festuca mexicana* Roem. & Schult., Syst. Veg. 2:732. 1817. Figure 33.

Perennial, caespitose, becoming bushy-branched, the branches decumbent and rooting from the lower nodes; culms slender, 10-100 cm. long, thin-walled, hollow, glabrous; nodes retrorsely silky-bearded; sheaths glabrous, ciliate on the margins, the collar pubescent; ligule a ciliate membrane, decurrent on the sheath margin, 1.2-4.0 mm. long;



FIG. 33. *Brachypodium mexicanum*. A, inflorescence; B, plant base; C, spikelet, pedicel, and rachis internode.

blades 4-15 cm. long, 2-6 mm. wide, appressed-hirsute above and beneath. Peduncle smooth or scabrous, up to 13 cm. long; racemes terminal on the main culm or on leafy branches, linear, 6-11 cm. long, sometimes reduced to 1-2 spikelets, especially when the plants are much-branched; spikelets erect, appressed to the rachis segments; pedicels villous, stiff, 1.0-2.5 mm. long. Spikelets 15-30 mm. long, readily disarticulating; first glume lanceolate, blunt at the tip, stiffish, 7-nerved, 5-10 mm. long; second glume similar, 6.5-10.5 mm. long; florets 5-12; lemmas 10-13 mm. long, lanceolate, 7-nerved, scabrid on the back, tapering into a short stiff awn 2-6 mm. long; palea 9-10 mm. long, conspicuously pectinate-ciliate on the keels; anthers 1.5-2.0 mm. long, yellow. Chromosome number $n = 19$ from Costa Rican material.

Mountains of central and southern Costa Rica; rare; elevations from 2,000-3,400 m. We have specimens from Irazú, Ascunción, and Chirripó Grande. Paramos and open pastures. Blooming probably year-long. Mexico, Guatemala, Costa Rica and northern Panama; Colombia and Venezuela to Bolivia.

This species is somewhat variable, especially in awn length and leaf blade size. Part of the leaf variation may be attributed to the stage of growth and degree of branching of the plants. Fournier, in *Mex. Pl.* 2:125, described two new species of *Brachypodium*, *B. subulatum* and *B. latifolium*. Most of the material cited by Fournier for his new species and *B. mexicanum* was collected from the summit of Istepec by Liebmann. It seems likely that all are variants of one species. Some of our Costa Rican material is a close match for the type of *B. subulatum* Fourn.

BRIZA Linnaeus

Caespitose annual grasses; inflorescence a panicle; spikelets several-flowered; glumes and lemmas very broad, blunt, placed at right angles to the rachilla; disarticulation above the glumes and between the florets; glumes faintly 3-nerved, circular, cucullate; lemmas circular, cordate at the base, faintly 5-7-nerved; palea much shorter and narrower than the lemma. (Pooideae: Poeae.)

Briza minor L., Sp. Pl. 70. 1753. Figure 34.

Caespitose annual; culms erect, simple, 20-50 cm. tall, branching from the base only; prophylla prominent at the base of the plant; culms 1-2 mm. thick, hollow, thin-walled, glabrous; nodes glabrous, dark, shrunk; leaves 2-4; sheaths glabrous, strongly ribbed, shorter than the internodes, the margins united for a short distance above the node; ligules membranaceous, the upper ones as much as 8 mm. long, their margins decurrent on the sheaths; leaf blades 6-13 cm. long, 4-8 mm. wide, glabrous; peduncle 10-15 cm. long, ridged, scaberulous. Panicle solitary, terminal, broadly pyramidal, 10-15 cm. long, often nearly as wide; branches solitary or paired, spreading. Spikelets solitary, pendent, tremulous on flexuous pedicels, deltoid in outline, broadest at the straight base, about as wide as long, 3.0-4.5 mm. long, mostly about 5-flowered; glumes subequal, 1.5-2.0 mm. long, faintly 3-nerved, circular but folded into an oblong-cucullate form; lemmas 1.5-2.0 mm. long, circular and cordate at the base, faintly 5-nerved, utriculate at the center, the



FIG. 34. *Briza minor*. Plant, spikelet, and a single floret.

palea closing off the cavity of the lemma; palea obovate, 1.0-1.5 mm. long, ciliate on the lateral margins; anthers 3, purplish, 0.7 mm. long. Chromosome number $n = 5$ from a Costa Rican specimen.

Occasional; roadsides, cultivated fields, pastures, middle elevations, from 1,800-2,600 m.; Poás, Barba, Irazú; Cordillera de Talamanca; San José. Blooming from August to March, possibly yearlong. Introduced from Europe; southern United States and Mexico; Guatemala; Costa Rica.

This delicate little grass is quite ornamental and is sometimes cultivated for the odd, trembling spikelets.

BROMUS Linnaeus

REFERENCE: T. R. Soderstrom & J. H. Beaman. The genus *Bromus* (Gramineae) in Mexico and Central America, Pub. Mus. Michigan State Univ., Biol. Ser. 3(5):465-520. 1968.

Plants annual or perennial, caespitose or rarely rhizomatous; culms unbranched; sheaths with united edges. Inflorescence a solitary terminal panicle. Spikelets several to many-flowered, laterally compressed; disarticulation above the glumes and between the florets; glumes unequal, acute or acuminate, 1-several-nerved, the second longer and usually wider than the first; lemmas 5-9-nerved, rounded or keeled on the back, usually awned, the awn arising just below the tip or between 2 apical teeth.

A large and diverse genus, mostly of temperate climates of the northern hemisphere. The spikelets are similar to those of species of *Festuca*, differing in the subapical awns of the lemmas and the usual presence of lateral teeth. Vegetatively, *Bromus* can be separated from *Festuca* by the united margins of the sheaths. (Pooideae: Poeae.)

KEY TO SPECIES OF *Bromus*

- 1a. Second glume 5-nerved; spikelets strongly flattened, glumes and lemmas acutely keeled *B. carinatus*
- 1b. Second glume 3-nerved; spikelets not strongly flattened; lemmas rounded on back *B. exaltatus*

Bromus carinatus Hook. & Arn., Bot. Beechey Voy. 403. 1840.
Bromus laciniatus Beal, Gr. N. Amer. 2:615. 1896. Figure 35.

Duration indefinite; plants caespitose, 35-120 cm. tall, erect; culms unbranched, 2-3 mm. thick, hollow, mostly glabrous, often retrorsely pilose on and below the nodes; sheaths mostly longer than the internodes, the lower ones often retrorsely pilose, the upper glabrous or nearly so; ligule a thin membrane, 1-3 mm. long; blades flat, 8-33 cm. long, 2-7 mm. wide, glabrous or with scattered weak hairs. Peduncle up to 15 cm. long; inflorescence a solitary terminal panicle, 15-36 cm. long, open, pyramidal, the lower branches up to 15 cm. long, naked below, the spikelets borne near the outer ends. Spikelets strongly laterally compressed, 1.5-3.5 cm. long, the glumes and lemmas

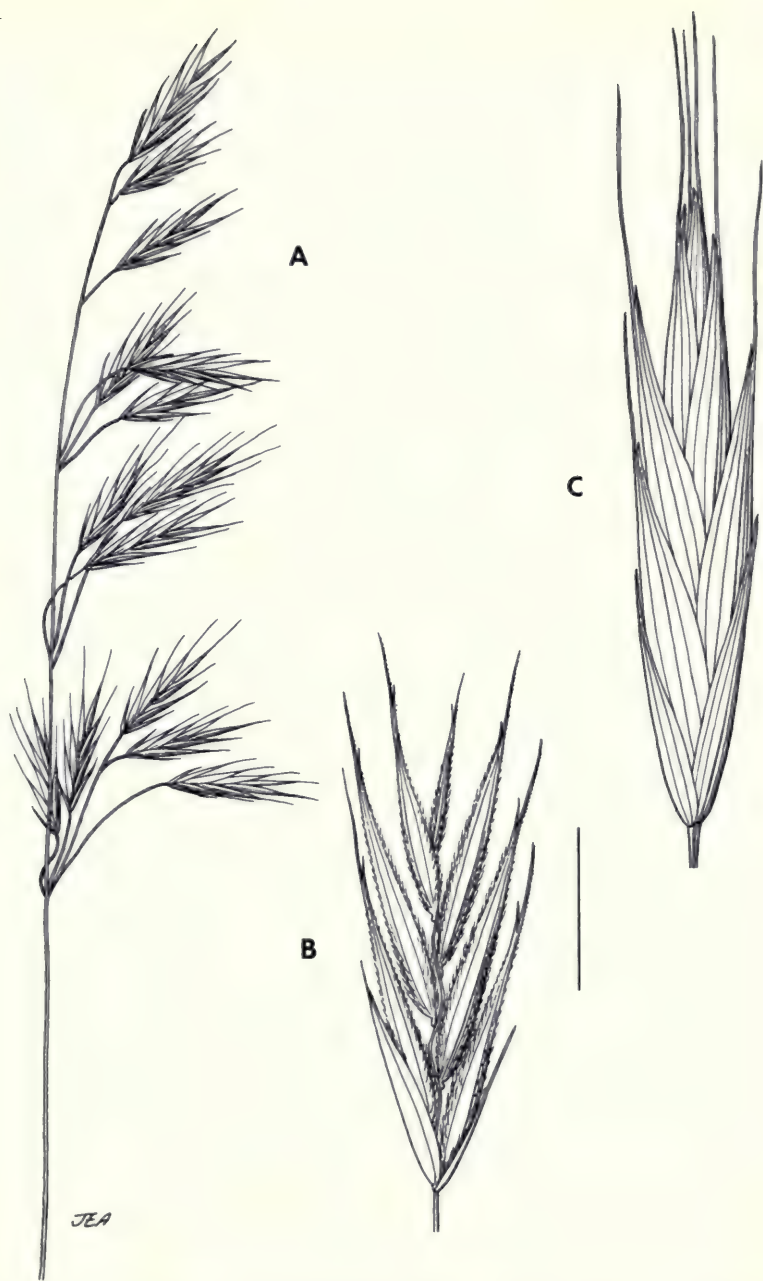


FIG. 35. *Bromus* species. *B. exaltatus*: A, inflorescence; B, spikelet; *B. carinatus*: C, spikelet.

strongly keeled; first glume 5-10 mm. long, 3-nerved, narrowly ovate; second glume 7-11 mm. long, 5-7-nerved, lanceolate-ovate; florets usually 6-8; lemmas 8-15 mm. long, lanceolate, 7-nerved, glabrous or pubescent on the margins; awn up to 10 mm. long, arising between inconspicuous teeth; palea slightly shorter than the lemma; anthers 3, yellow. Some plants which are presumably cleistogamous have small anthers, 0.7-1.0 mm. long, remaining tangled with the stigmas; others have large anthers, 3.5-6.5 mm. long. Both types have the same chromosome number and are externally similar. Chromosome number $n = 28$ from two Costa Rican collections.

Roadsides and pastures, occasional, from 1,700-2,600 m. elevation. August and September. Western United States to Costa Rica.

Bromus catharticus Vahl has been reported from Costa Rica by Soderstrom & Beaman (1968). The basis of this report was a specimen apparently cultivated in the garden of the National Museum in San José, and no evidence exists that the species ever became established in Costa Rica. This species has recently been passing under the name *B. unioides* H.B.K. Pinto-Escobar has now shown that the proper name is *B. catharticus* (Caldasia 11:54:9-16).

Bromus exaltatus Bernh., Linnaea 15:Litt. 90. 1841. Figure 35.

Perennial; plants 45-80 cm. tall; culms erect from decumbent bases; unbranched; old sheaths remaining as fibrous remnants; culms hollow, ca. 2 mm. thick, unbranched, glabrous or slightly retrorsely pilose, especially below the nodes; lower sheaths mostly longer than the internodes and overlapping, densely retrorsely pilose; upper sheaths less pubescent; ligule a brownish membrane, 1-2 mm. long; leaf blades flat, 10-30 cm. long, 3-7 mm. wide, scabrous on the margins, glabrous beneath, the upper surface with scattered weak hairs. Peduncle 10-12 cm. long, glabrous; inflorescence a solitary terminal panicle, open and nodding, 10-22 cm. long, rather narrow, the branches 1-3 per node, few-flowered, rarely up to 11 cm. long; pedicels minutely antrorsely scabrous, short or longer than the spikelets. Spikelets laterally compressed, 2.5-3.2 cm. long, usually with 5-6 florets, the terminal one reduced and sterile; disarticulation above the glumes and between florets; first glume linear-lanceolate, acuminate, 1-nerved, 5.0-11.5 mm. long; second glume broadly lanceolate, acuminate, 3-nerved, 8.5-14.0 mm. long; florets 12-17 mm. long, excluding the 2.5-4.0 mm. long awns; lemmas 5-nerved, lanceolate, rounded on the back, tapering to the base of the awn, the lateral teeth usually inconspicuous; margins, base, and lower part of the back more or less appressed pilose; glumes and lemmas often purplish and with golden margins; palea 8.7-10.5 mm. long, narrowly elliptical, the keels scabrous, the back sometimes with a few hairs; anthers 3, yellow, 2.2-2.8 mm. long. Chromosome number $n = 7$ from a Costa Rican specimen.

Rare, paramos above 3,200 m. elevation, near Asunción; Chirripó Grande. July to August. Southern Mexico; Guatemala; Costa Rica; Volcán Chiriqui in Panamá.

CALAMAGROSTIS Adanson

Perennial caespitose or rhizomatous grasses; inflorescence a usually narrow or contracted terminal panicle. Spikelets small, 1-flowered, laterally compressed, the subequal

glumes 1- or sometimes 3-nerved, keeled, longer than the floret; disarticulation above the glumes; floret 1; lemma 5-nerved, awned from the back or between 2 teeth; callus bearded; palea nearly as long as the lemma; rachilla in our species prolonged behind the palea as a hairy or naked bristle.

A large genus of grasses of the temperate and arctic regions, sparingly represented at high elevations in the tropics. The endosperm in some species is pasty, as in *Trisetum*. (Pooideae: Agrostaeae.)

KEY TO SPECIES OF *Calamagrostis*

- 1a. Rachilla internode behind palea glabrous or with few short hairs not exceeding its tip; awn inserted near base of lemma..... *C. nuda*
- 1b. Rachilla internode heavily bearded, with long hairs extending beyond its tip; awn inserted near or above middle of lemma..... 2
- 2a. Culms erect, in dense clumps; leaf blades tightly involute; sheaths auricled; anthers 3, 2.5-2.8 mm. long..... *C. intermedia*.
- 2b. Culms decumbent at base; leaf blades mostly flat, sheaths not auricled; anthers 2, 1.2-1.4 mm. long..... *C. pittieri*

Calamagrostis intermedia (Presl) Steud., Nom. Bot., ed. 2. 1:250. 1840. *Deyeuxia intermedia* Presl, Rel. Haenk. 1:249. 1830. Figure 36.

Perennial, in dense hard tussocks; plants 45-110 cm. tall, stiffly erect; culms 1.5-3.0 mm. thick, hollow, glabrous; sheaths mostly basal, densely overlapping; culm leaves about 2; sheaths glabrous, the apex on one side prolonged into a stiff rounded auricle, 1.5-3.5 mm. long, continuous with the ligule; ligule a stiff membrane, 1.0-2.9 mm. long; leaf blades mostly from the base of the plants, stiff and rigid, tightly involute, 1.0-1.5 mm. thick as rolled, 10-45 cm. long, tapering abruptly to a point, scaberulous beneath. Peduncle included or exerted up to 20 cm.; inflorescence a solitary terminal panicle, purple, 12-35 cm. long, loosely cylindrical, tapering to a narrow apex, the ascending lower branches up to 8 cm. long; panicle somewhat interrupted, the scabrous axis and branches partially exposed; spikelets appressed along the branches; pedicels slender and scabrous, shorter or longer than the spikelets. Spikelets laterally compressed, the glumes subequal, keeled, lanceolate-attenuate, 6-8 mm. long exceeding the floret, the tips recurved; disarticulation above the glumes; lemma lanceolate, 5.0-6.5 mm. long, the callus rather short, sparsely bearded with hairs less than 1 mm. long; back scaberulous; nerves faint; apex tapering into 2 teeth about 1 mm. long; awn inserted on the back below the middle, geniculate, 7-11 mm. long; palea broad, 4-5 mm. long, the apex truncate; anthers 3, yellow or purple, 2.5-2.8 mm. long; rachilla 1.5-3.5 mm. long, the hairs appressed, those at the apex 1.0-1.5 mm. long. Chromosome number $n = 28$ from a Costa Rican specimen.

Occasional, Cordillera de Talamanca, mostly on paramos above 3,100 m. elevation; Cerro de la Muerte, Chirripó Grande. Apparently blooming yearlong. Plants from the highest elevations of Chirripó Grande are markedly smaller than average. Costa Rica to Argentina.



FIG. 36. *Calamagrostis* species. *C. nuda*: A, floret and spikelet; *C. intermedia*: B, floret and spikelet; C, inflorescence; *C. pittieri*: D, floret and spikelet.

***Calamagrostis nuda* (Pilger) Pilger, Bot. Jahrb. Syst. 42:60. 1908.**
***Deyeuxia nuda* Pilger, Bot. Jahrb. Syst. 27:29. 1899. Figure 36.**

Perennial; plants erect, in large, dense tufts up to 60 cm. in diameter; culms 45-95 cm. tall, unbranched, hollow, thin-walled, 1.5-2.0 mm. thick, minutely scaberulous; nodes purple, up to 2 mm. high, not prominent; culm leaves up to 4, the uppermost one reduced; sheaths much shorter than the internodes, the lower ones breaking down into stiff fibers, lower sheaths sometimes with a few scattered weak appressed long hairs, otherwise glabrous; ligule 3.5-5.0 mm. long, a firm rounded membrane, decurrent on the sheath margins; blades stiff, strict, mostly involute, up to 5 mm. wide when unrolled, 2 mm. thick when rolled, smooth or scabrid beneath, scabrous-puberulent and deeply grooved above. Peduncle included or exserted up to 17 cm.; inflorescence a solitary terminal panicle, densely cylindrical, lobed, purple, 12-15 cm. long, 1.0-1.5 cm. thick, the spikelets densely overlapping on the short, erect branches, short-pedicellate; pedicels and branches scabrous. Spikelets laterally compressed, purple or greenish, disarticulating above the glumes, 3.7-4.1 mm. long, the glumes subequal, exceeding the floret; first glume 1-nerved, the second sometimes weakly 3-nerved, both strongly keeled, scabrous on the upper half of the keel, ovate, acuminate; lemma ovate, 3.3-3.5 mm. long, the tip erose or 4-toothed; callus hairs scant or lacking, usually less than 0.5 mm. long; back of lemma scabrous; awn inserted near the base of the lemma, rather thick and scarcely twisted or geniculate, slightly exceeding the lemma and exserted at the tip of the glumes, 3.3-3.4 mm. long; palea slightly shorter than the lemma, 2.8-3.3 mm. long; anther 1, yellow or purple, 1.2-1.5 mm. long; rachilla internode 0.7-1.0 mm. long, naked or with a few short hairs. Chromosome number $n = 35$ from a Costa Rican specimen.

High paramos, 3,300-3,500 m. elevation; Asunción, Buena Vista, Chirripó Grande. January and July. This species was previously known only from South America.

***Calamagrostis pittieri* Hack., Oesterr. Bot. Z. 52:108. 1902.**
Figure 36.

Perennial; plants 30-100 cm. tall, erect, the bases of the culms often decumbent; culms unbranched, glabrous or rarely with a few weak hairs below the nodes, 1-3 mm. thick, hollow; nodes mostly glabrous, yellow or purple; sheaths mostly shorter than the internodes, retrorsely pilose or the upper ones glabrous; ligules 1.0-3.0 mm. long, membranaceous; leaf blades 10-30 cm. long, 3-6 mm. wide, ridged and pilose above, flat or folded. Peduncle included or exserted up to 26 cm.; inflorescence solitary, terminal, a loosely cylindrical panicle, tapering to a narrow apex, the ascending branches densely clothed with overlapping spikelets. Spikelets often purplish, silky because of the evident rachilla hairs, overlapping, appressed along the branches; pedicels short, scabrous. Spikelets laterally compressed, 5-6 mm. long; glumes subequal, lance-attenuate, 5-6 mm. long; scabrous on the keels, often purple-striate, the first 1-nerved, the second weakly 3-nerved; floret disarticulating above the glumes and shorter than them; lemma 3.8-4.5 mm. long, lanceolate, the callus acute, sparsely bearded with hairs less than 1 mm. long; nerves faint; awn 4.2-5.7 mm. long, geniculate, twisted below, exserted from the glumes, attached between 2 acuminate apical teeth 1.2-1.7 mm. long; palea 2.8-3.5 mm. long, the apex bidentate; anthers 2, 1.2-1.4 mm. long; caryopsis spindle-shaped, 2.0 mm. long, soft and pasty; rachilla internode 1.3-2.1 mm. long, heavily bearded with white hairs, those at the apex ca. 2.5 mm. long. Chromosome number $n = 14$ from a Costa Rican specimen.

Paramos of the Cordillera de Talamanca: Buena Vista, Asunción, Chirripó Grande; brushy roadsides in *Quercus* forests; elevations 2,700-3,450 m. July to October. Apparently confined to Costa Rica.

CENCHRUS Linnaeus

REFERENCE: D. G. DeLisle, Taxonomy and distribution of the genus *Cenchrus*, Iowa State Univ. J. Sci. 37:259-351. 1963.

Plants annual or perennial, caespitose, the culms solid or hollow, often decumbent and rooting at lower nodes. Inflorescences terminal on the culms or on leafy branches; inflorescence unbranched, a dense spike of detachable involucres, borne singly at the nodes of a flattened, flexuous rachis; each involucre (fascicle or bur) consisting of numerous bristly hairs or flattened retrorsely barbed spines, these more or less connate at the base and permanently enclosing several sessile spikelets. Spikelets dorsally compressed; first glume 1-3-nerved, usually about half as long as the spikelet; second glume and lower lemma subequal, as long as the spikelet; second glume 1-7-nerved; lower lemma herbaceous, ovate, acuminate, 3-7-nerved, containing a 2-nerved palea about equal in size and usually a staminate flower with enlarged anthers; upper floret perfect-flowered, the lemma chartaceous, 5-7-nerved, ovate and acuminate, its margins enveloping the edges of the palea, not inrolled; palea broad, acuminate, 2-nerved, chartaceous, equal to the lemma; flower lacking lodicules; anthers 3; caryopsis elliptic or ovoid, plump.

A genus of about 20 species, widespread in temperate and tropical regions of both eastern and western hemispheres. The plants are found frequently on disturbed or sandy soils. *Cenchrus* is closely related to *Pennisetum*, differing in the connate spines, but some species have been shifted from one genus to the other. *Setaria*, *Antheophora*, and the subgenus *Paurochaetium* of *Panicum* are also in the same affinity group. *Cenchrus* plants are readily recognizable in most cases by the pungent adhering burs, by which the spikelets are readily dispersed by man and animals. The spines inflict painful puncture wounds which readily become infected. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Cenchrus*

- 1a. Spines and bristles retrorsely barbed, so that burs readily adhere to objects when brushed upwardly 2
- 1b. Spines antrorsely scabrous, not adhering when brushed upwardly *C. pilosus*
 - 2a. Spines separate to base of bur, spikelet exposed between them *C. myosuroides*
 - 2b. Lower half of spines united into flat plates, forming a more or less solid bur concealing the spikelets 3
- 3a. Burs with a ring of slender bristles at the base, much finer than flattened inner spines of bur 4
- 3b. Burs lacking outer ring of bristles, all spines about the same size *C. incertus*
 - 4a. Inflorescence very dense, the burs completely hiding rachis; internodes of rachis between 2 adjacent burs less than 2 mm. long; body of burs (excluding the

- spines) less than 4.5 mm. wide, burs stramineous; some outer bristles about as long as the bur *C. brownii*
- 4b. Inflorescence not dense, rachis partly visible between burs; rachis internodes 2-3 mm. long; body of burs 3.5-6.0 mm. wide; burs often purplish; outer bristles usually less than half as long as bur *C. echinatus*

Cenchrus brownii Roem. & Schult., Syst. Veg. 2:258. 1817. *C. viridis* Spreng., Syst. Veg. 1:301. 1825. Figure 37.

Duration indefinite; culms erect to long-decumbent and rooting at the lower nodes, 25-95 cm. long, glabrous, solid or hollow; sheaths mostly longer than the internodes, keeled, the margins more or less pilose; ligules 0.6-1.3 mm. long, ciliate; blades flat, 8-30 cm. long, 4-11 mm. wide, the upper surface sometimes pilose. Inflorescences terminal on leafy branches, 3-12 cm. long, densely cylindrical, 1.0-1.5 cm. wide. Burs globose, 2.0-4.5 mm. wide (5-8 mm. including the bristles), the stipe and lower parts of the spines villous; some outer bristles as long as the bur; inner spines flattened, often bent and interlocking; both spines and bristles retrorsely barbed. Spikelets 2-3 per bur, sessile and permanently attached at the base of the bur, dorsally compressed, 4-6 mm. long; first glume 0.5-2.5 mm. long, 1-nerved; second glume 2.2-4.9 mm. long, 3-5-nerved; lower lemma 3.5-5.5 mm. long, its palea equal; upper floret perfect flowered; lemma 3.6-5.4 mm. long, ovate-acuminate, glabrous; anthers 3, 0.8-2.3 mm. long. Chromosome number $n = 17$ from a Costa Rican specimen.

Roadsides, pastures, beaches, waste ground; common in Guanacaste, scattered elsewhere; elevations sea level to 100 m., rarely to 600 m. June to October. Florida Keys; Río Grande Valley; West Indies; Southern Mexico to northern South America, rarely elsewhere; introduced in South Africa, the Philippines and tropical Asia.

This species is very closely related to *C. echinatus*, differing in the much denser inflorescence, smaller burs, shorter rachis internodes, and in usually being diploid.

Cenchrus echinatus L., Sp. Pl. 1050. 1753. *C. insularis* Scribn. ex Millsp., Publ. Field Mus., Bot. Ser. Vol. II:26. 1900. Figure 37.

Duration indefinite; culms 15-85 cm. long, glabrous, solid or hollow, ascending from long-decumbent and rooting bases; branching abundant from the decumbent culm bases; sheaths keeled, mostly overlapping, glabrous to heavily pubescent; ligules 0.7-1.7 mm. long, ciliate; blades flat, 4-26 cm. long, 3.5-11 mm. wide, glabrous or with scattered long weak hairs on the upper surface near the base. Inflorescences terminal on leafy branches, exserted, cylindrical, 2-10 cm. long, up to 2 cm. wide, the burs spaced, the flexuous rachis often visible between them; rachis internodes 2-3 mm. long. Burs globose, 5-10 mm. long, 3.5-6.0 mm. wide; outer slender bristles much shorter than the flat, mostly erect inner spines; color of burs often purplish. Spikelets 2-3 per bur, dorsally compressed, sessile within the bur and permanently attached to it, 5.0-7.0 mm. long; first glume 1.3-3.4 mm. long; second glume 3.8-5.7 mm. long, 3-6-nerved; lower lemma 4.5-6.4 mm. long, the palea slightly longer, scabrous; upper lemma 4.7-7.0 mm. long, ovate-acuminate; anthers 0.8-2.4 mm. long. Chromosome number in recent American specimens, $n = 34$.



FIG. 37. *Cenchrus* species. *C. echinatus*: A, bur; *C. incertus*: B, bur; *C. pilosus*: C, bur; *C. brownii*: D, bur; E, plant and inflorescence.

Beach of Caribbean Sea, between Río Banano and the Limón Airport; beach at Tortugero; Cahuita. July to September, probably year-long. Transcontinental in the southern United States, southward to southern South America; West Indies. Introduced in the Pacific Islands, China, and Australia.

This species is closely related to *C. brownii*, differing in the more open inflorescence, short outer bristles of the burs, and larger bur size, as well as in the chromosome number.

Cenchrus incertus M. A. Curtis, Boston J. Nat. Hist. 1:135. 1835. *C. pauciflorus* Benth., Bot. Voy. Sulph. 56. 1844. Figure 37.

Duration indefinite; plants decumbent to erect, the culms 5-80 cm. long, sometimes stoloniferous or rhizomatous on shifting sands; branching abundant; culms round, 1-2 mm. thick, glabrous, solid with a pithy center; leaf sheaths keeled, longer or shorter than the internodes, glabrous to pilose, the upper margins and throat pilose; ligule ciliate, 0.5-1.5 mm. long; leaf blades flat or folded, 2-18 cm. long, 2-6 mm. wide, glabrous beneath, loosely pilose above. Inflorescences terminal on leafy branches, 2.0-8.5 cm. long, 8-20 mm. wide, cylindrical, the rachis flexuous, visible between the burs; internodes 2.0-5.0 mm. long. Burs (fascicles) stramineous to purplish, the body ovoid to globose, split on 2 sides, pubescent, 5-10 mm. long, the body 2.5-5.5 mm. wide, the stipe up to 2 mm. long; spines 8-40, more or less flattened, to 2 mm. wide, retrorsely barbed, 2.0-2.5 mm. long. Spikelets sessile and permanently attached within the bur, 2-4 per bur, dorsally compressed, 3.5-5.8 mm. long; first glume 1.0-3.3 mm. long, 1-nerved; second glume 2.8-5.0 mm. long, 5-7-nerved, ovate-acuminate; lower lemma similar, 3.0-5.9 mm. long, 4-7-nerved, the palea 3.5-6.2 mm. long; fertile lemma chartaceous, 3.4-6.0 mm. long, ovate-acuminate, 3-nerved, the broad margins covering the margins of the palea but not involled, glabrous; anthers 3, 0.5-2.0 mm. long. Chromosome number $n = 17$ from a Costa Rican specimen.

Sandy beaches near ports, Puntarenas, Boca de Barranca, Puerto Limón; June and July, but probably blooming yearlong; possibly introduced. Transcontinental in the southern United States, southward to Panama; West Indies; central South America.

Cenchrus myosuroides H.B.K., Nov. Gen. & Sp. 1:115, t. 35. 1816.

Caespitose perennial, from a hard base; plants 0.5-2.0 m. tall, erect or leaning, branching from the base or the lower culm nodes; prophylla prominent, up to 6 cm. long; culms glabrous, round, thick-walled, with a small lumen; nodes dark, glabrous; sheaths glabrous, longer than the internodes, keeled toward the apex; ligule a short, thick membrane, crowned with a circle of hairs longer than the membrane, in total 1.5-3.4 mm. long; leaf blades flat, glabrous or slightly pilose, strongly scabrous-margined, 12-38 cm. long, 4-13 mm. wide. Inflorescence a solitary narrowly cylindrical terminal spike of fascicles, borne on a short glabrous peduncle; length 6.5-23 cm., thickness 0.6-1.5 cm.; rachis puberulent, the internodes up to 1.7 mm. long. Burs numerous, 3.8-8.1 mm. long, 1.2-3.0 mm. thick, with a short, thick basal stipe; spines numerous, 3-6 mm. long, retrorsely barbed, 0.2-0.6 mm. thick; spikelets usually 1 per bur, rarely 2-3. Spikelets ovoid, acute, 3.8-5.6 mm. long; first glume deltoid, acute, 1-nerved, 1.5-3.0 mm. long;

second glume 3.1-5.0 mm. long, ovate, acute, 3-5-nerved, the margins clasping the sterile lemma; palea of sterile lemma lacking or present as a tongue-shaped membrane nearly as long as the lemma; anthers not seen; fertile lemma ovoid, 3-5-nerved, 3.8-5.4 mm. long, acute; palea about equal, grooved; anthers 3, 1.2-2.2 mm. long; caryopsis elliptical, tan, 1.5-2.6 mm. long.

The only Central American specimen is the following. Costa Rica: Limón, Uvita, 17 July 1932, *Stork 3218*, F. Southern Florida; Caribbean Islands; southern Texas, Mexico; South America to central Argentina.

Cenchrus pilosus H.B.K., Nov. Gen. & Sp. 1:116, t. 36. 1816.
Figure 37.

Duration indefinite; plants erect to decumbent, the culm bases rooting; culms 30-70 cm. long, 2-3 mm. thick, round, solid, or hollow, glabrous; branching abundant; prophylla prominent, up to 30 mm. long; sheaths keeled, longer or shorter than the internodes, glabrous or scabrous; ligules 0.5-1.6 mm. long, ciliate; blades flat, 6-30 cm. long, 4-11 mm. wide, glabrous or the upper surface long-pilose near the base. Peduncles exerted; inflorescence a dense spike of fascicles (burs), terminal on the main culm or on leafy branches, 2-13 cm. long, up to 2 cm. thick, including the spreading bristles; spikelets borne in densely overlapping burs on a strongly angled but not zig-zag rachis, its nodes pilose. Burs numerous, globose, the body 5.0-8.0 mm. long, 3.0-5.5 mm. wide, but appearing much larger because of the spreading outer bristles, tan or purplish, the flattened obconical basal stipe and the flattened interlocking inner spines pilose; spines 3.0-6.0 mm. long; outer bristles numerous, many twice as long as the spines, both spines and bristles antrorsely scabrous, the burs not clinging to objects as in the other species. Spikelets 2-3 per bur, dorsally compressed, 6.0-7.5 mm. long; first glume 1.0-4.0 mm. long; second glume caudate-ovate, the broad margins embracing the palea but not in-rolled; anthers 3, 0.9-1.8 mm. long; caryopsis ovoid, 2.2-3.0 mm. long. Chromosome number $n = 17$ from Costa Rican specimens.

Common around Cañas and scattered elsewhere in Guanacaste; Atenas; elevations up to 600 m.; savannas, pastures, roadsides. June to November. Southern Mexico and Yucatan to Costa Rica; northwestern South America.

CHAETIUM Nees

REFERENCE: M. B. Montiel, Determinación taxonómica de la especie *Chaetium bromoides* (Presl) Benth. basada en el estudio anatómico, *Revista Biol. Trop.* 20:45-79. 1972.

Caespitose perennial; inflorescence a dense erect panicle; spikelets lanceolate, dorsally compressed, plano-convex, with a sharp pubescent callus formed of the base of the first glume, united with the rachilla internode; glumes equal, herbaceous, both longer than the florets, both bearing long awns; sterile and fertile lemmas equal, chartaceous, tapering into short awns; edges of fertile lemma enclosing the margins of the palea, not

inrolled; palea firm, flat, tapering to an awn-tip, nearly as long as the lemma; disarticulation at the base of the callus, very oblique. (Panicoideae: Paniceae.)

Chaetium bromoides (Presl) Benth. ex Hemsl., Biol. Centr. Amer. Bot. 3:503. 1885. *Berchtoldia bromoides* Presl, Rel. Haenk. 1:324, pl. 43. 1830. Figure 38.

Caespitose perennial, rarely producing stolons; culms erect or spreading, 50-100 cm. tall, simple or somewhat branched above; prophylla prominent, 5-9 cm. long, pubescent near the tip; culms 2-3 mm. thick, glabrous and shining, hollow, the cavity small; nodes upwardly bearded or glabrescent; leaf sheaths keeled, shorter than the internodes, glabrous except for the upper margins and the collar; ligules prominent, 1.5-2.5 mm. long, of densely crowded white hairs; blades 10-30 cm. long, 3-7 mm. wide, sparsely papillose-pilose on both surfaces, rarely puberulent as well; peduncles included or exerted as much as 30 cm.; panicles terminal on the culm or on leafy branches, 10-23 cm. long, 1-2 cm. wide, the branches erect and appressed; spikelets greenish or purple, dorsally compressed, plano-convex, 8-10 mm. long (excluding awns); disarticulation below the glumes, at the base of a slender pilose callus 1.5-2.5 mm. long formed by the union of the first glume and the lower rachilla joint; disarticulation very oblique; glumes subequal, lanceolate, the first 7-10 mm. long, the second 6-8 mm., both broad and concealing the florets, 5-7-nerved, scabrid on the nerves, tapering into erect awns 10-35 mm. long; sterile lemma 6-8 mm. long, smooth and glabrous, narrowly ovate, faintly 3-nerved; fertile floret 6-8 mm. long; lemma smooth, chartaceous, the margins flat, covering the margins of the palea; lemma with an awn up to 2 mm. long; nerves faint; anthers 3, purple, 1.5 mm. long. Chromosome number $n = 13$ from Costa Rican specimens.

Common in the Meseta Central; open or partially shaded areas; lawns, roadsides, disturbed areas; 1,000-2,000 m. elevation. Blooming apparently occurs throughout the year. Mexico to Costa Rica.

CHLORIS Swartz

REFERENCE: D. Anderson, Taxonomy of the genus *Chloris* (Gramineae), Brigham Young Univ. Sci. Bull., Biol. Ser. 19:2:1-132. 1974.

Annual or perennial caespitose, stoloniferous or rhizomatous grasses; culms solid, pithy. Inflorescence of 1 or more whorls of 1-sided spikes; spikelets sessile or nearly so, appressed in 2 rows along the lower sides of a slender triquetrous rachis. Spikelets laterally compressed, disarticulating above the glumes; glumes narrow, acuminate, 1-nerved; fertile florets 1-several, the lemma 3-nerved, the lateral nerves marginal; nerves usually ciliate, especially above; callus bearded; awn inserted just below the bifid apex of the lemma; palea about equal to the lemma; rachilla prolonged beyond the fertile floret and bearing 1 to several rudimentary lemmas.

A large genus of grasses of warm climates of both Old and New Worlds. The genus is related to *Eustachys*, *Bouteloua*, and *Gymnopo-*

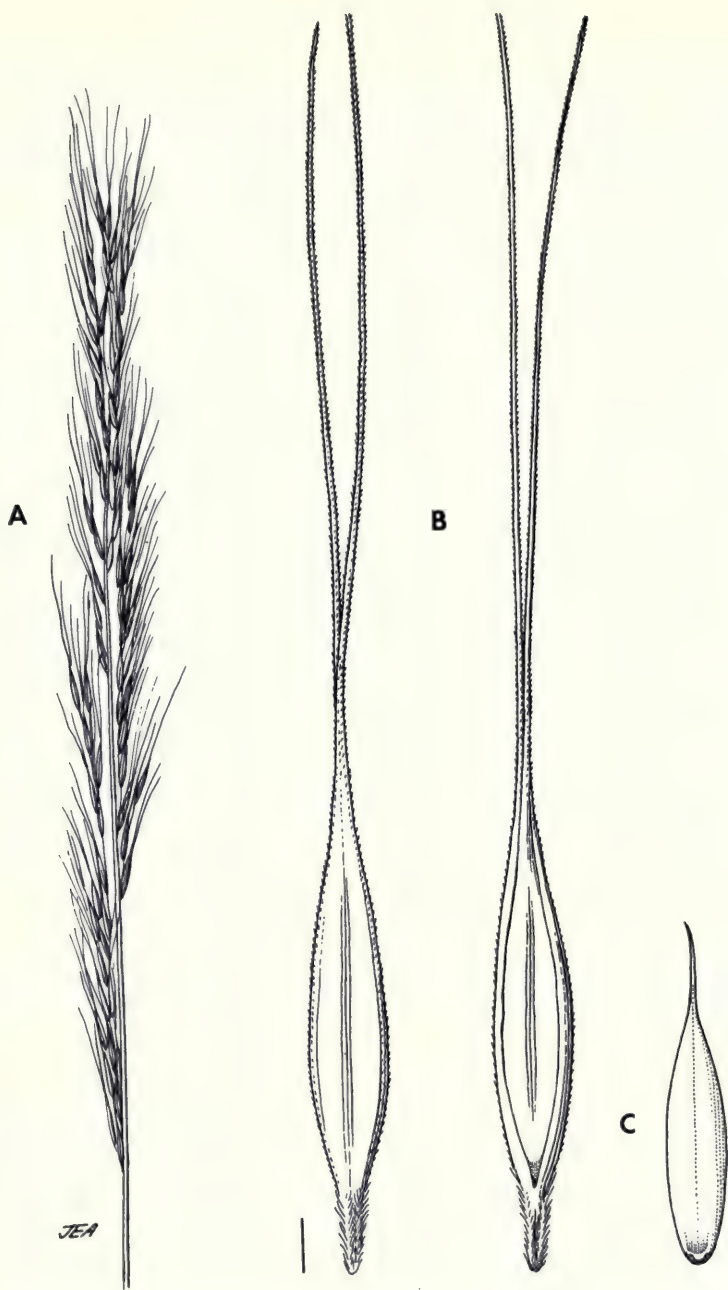


FIG. 38. *Chaetium bromoides*. A, inflorescence; B, two views of a spikelet; C, fertile floret.

gon. Some of the species are common tropical weeds, and one, *C. gayana*, is an important forage grass. (Chloridoideae: Chlorideae.)

KEY TO SPECIES OF *Chloris*

- 1a. Florets 3-5, the lowermost 1 or 2 producing grains, upper ones sterile or rudimentary; cultivated crop *C. gayana*
- 1b. Florets 2, second sterile and rudimentary; wild plants 2
- 2a. Spikelets 2.5-3.5 mm. long, greenish; fertile lemma 2.5-3.4 mm. long; spikes somewhat flexuous *C. radiata*
- 2b. Spikelets 3.8-4.1 mm. long, purple-tinged; fertile lemma 3.4-4.0 mm. long; spikes stiff *C. aristata*

Chloris aristata (Cerv.) Swallen, N. Amer. Fl. 17:8: 596. 1939.
Agrostomia aristata Cerv. Naturaleza 1: 345. 1870. ? *Chloris rufescens* Lag.?, Varied. Ci. 4:143. 1805. Figure 39.

Duration indefinite; plants forming small circular patches, the culms arising from short stoloniferous bases; culms unbranched, 15-60 cm. tall, 2 mm. thick, solid, pithy, glabrous; nodes dark, contracted; sheaths shorter than the internodes, strongly keeled, glabrous, glaucous; ligule a short membrane, densely ciliate with a dense row of stiff white hairs, ca. 1 mm. long; leaf blades flat or folded, blunt-tipped, 1-13 cm. long, 1.5-4.0 mm. wide, the uppermost usually much reduced, scabrous especially on the margins and on the keeled midrib below, often bearing scattered long weak hairs. Peduncle exserted 4-15 cm., pilose at the apex; inflorescence vase-shaped, of 5-7 spikes, mostly in a single whorl, or with a solitary spike attached just below the others; spikes 3-8 cm. long; spikelets appressed in 2 rows along the lower side of the slender triquetrous rachis, overlapping. Spikelets 3.8-4.1 mm. long, the glumes and lemmas keeled; glumes 1-nerved, subulate to narrowly lanceolate, acuminate, scabrous on the keel; first glume 2.0-2.2 mm. long, the second 3.2-4.0 mm. long; fertile lemma 3.4-4.0 mm. long, ovate, acute, the keel bowed out; slightly bifid at the apex, the awn 9-10 mm. long, attached about one-fourth below the apex; lateral nerves marginal, ciliate on the upper half; callus short-bearded; palea equal to the lemma or slightly longer, the lower part infolded around the rachilla segment, the upper half dilated, scabrous-ciliate on the upper margins; anthers 3, yellow, 0.5-0.8 mm. long; rachilla segment slender, ca. half the length of the fertile lemma, rudiment 1.7-2.0 mm. long, cylindrical, truncate, consisting of an empty lemma bearing an awn 2.5-4.0 mm. long; spikelets often purplish. Chromosome number $n = 50$.

Occasional; roadsides and open areas, mostly in the Meseta Central; Palmares. Blooming apparently yearlong. Mexico and Guatemala; Costa Rica.

This is the species which was called *C. orthonoton* Doell in Grasses of Central America. That species, however, is Brazilian and differs in a number of characters from *C. aristata*.

Chloris gayana Kunth, Rév. Gram. 1:89. 1829.

Vigorous stoloniferous perennial; plants up to 1.5 m. tall; stolons stout, elongated; erect branches arising freely from the nodes; prophylla prominent, 2-3 cm. long; culms

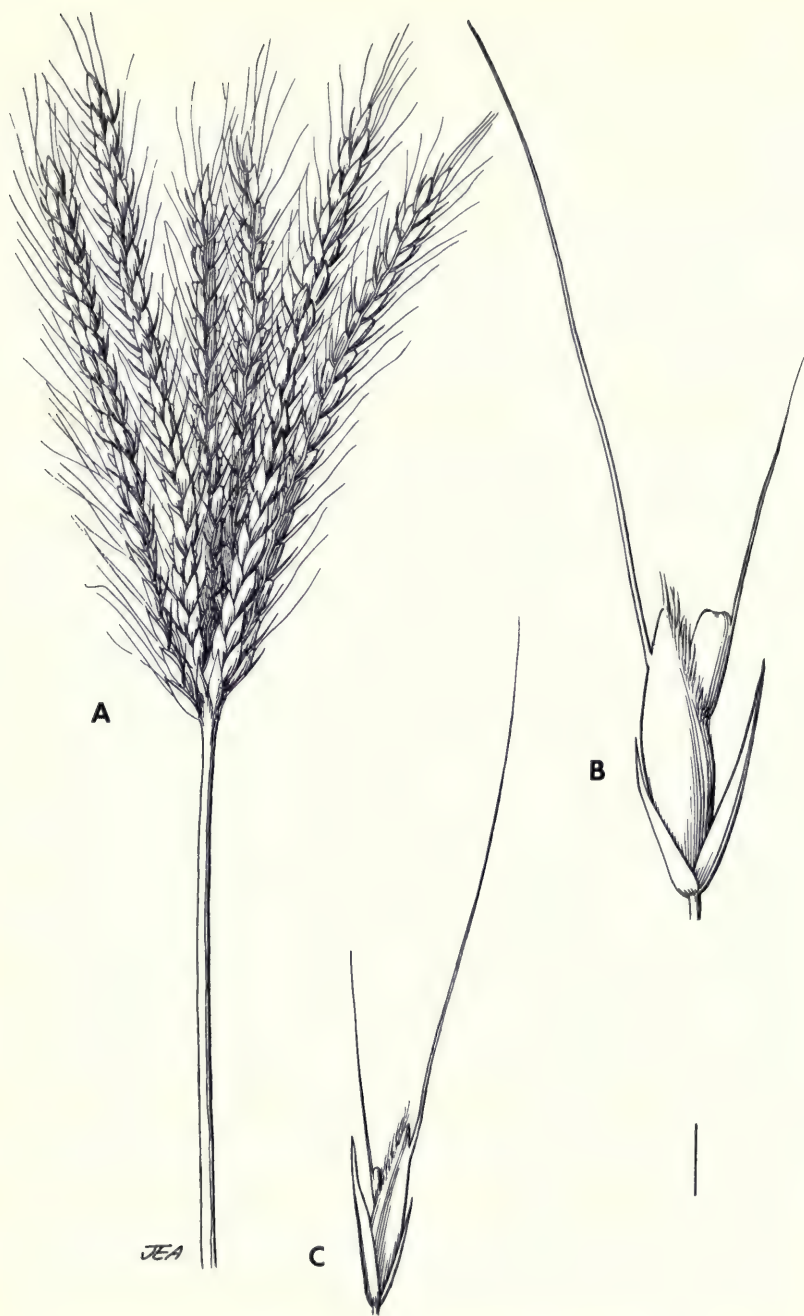


FIG. 39. *Chloris* species. *C. aristata*: A, inflorescence; B, spikelet; *C. radiata*: C, spikelet.

glabrous, solid, pithy; nodes glabrous, contracted; sheaths glabrous, somewhat keeled; ligule a minutely ciliate membrane, 0.3-0.5 mm. long, a conspicuous tuft of stiff papillose-based hairs borne just behind it; blades flat, acuminate, 20-45 cm. long, 4-7 mm. wide, glabrous or scabrous, sometimes with scattered long papillose-based hairs on the upper surface. Inflorescences terminal on the culms, consisting of a single dense whorl of 6-16 rather thick, somewhat flexuous spikes, each 5-9 cm. long, the spikelets in 2 somewhat overlapping rows on the lower sides of the triquetrous rachis. Spikelets 3-5 mm. long, disarticulating only above the glumes; florets 3-5, the lower 1 or 2 producing grains, the upper ones staminate or sterile; lower lemma 2.7-3.8 mm. long, ovate, pubescent on the callus and marginal nerves, the hairs longer near the apex; awn 2-4 mm. long, flexuous, attached just below the apex of the lemma; palea slightly longer than the lemma; upper lemmas glabrous, successively shorter than the first lemma, the ultimate one a small obconical empty rudiment; anthers 3, yellow, ca. 2 mm. long.

Native to Africa; cultivated in the grass garden at the IICA at Turrialba; possibly cultivated for forage elsewhere. "Rhodes grass."

***Chloris radiata* (L.) Swartz, Prodr. Veg. Ind. Occ. 26. 1788. *Agrostis radiata* L., Syst. Nat. 10. 2:873. 1759. Figure 39.**

Duration indefinite; plants spreading by short stout freely branching stolons and making circular patches; culms erect to spreading, 15-60 cm. long; prophylla prominent, up to 4 cm. long; culms solid, pithy, glabrous, flattened; foliage glaucous, scabrous, glabrous or softly hirsute; sheaths strongly flattened and keeled; ligule a minutely ciliate membrane, 0.5-0.7 mm. long; leaf blades 6-12 cm. long, 3-5 mm. wide, strongly keeled, especially near the base, blunt-tipped, scabrous on the margins and midrib, sometimes on the surface, usually hirsute above, sometimes on both surfaces; dewlap prominent. Inflorescence solitary, terminal, vase-shaped, of 1-2 closely spaced whorls of lax spikes, each 3.5-7.0 cm. long; spikes 4-18 per inflorescence; spikelets appressed in 2 rows along the lower sides of the slender triquetrous rachis. Spikelets laterally compressed, 2.5-3.5 mm. long, the glumes and lemmas keeled; first glume linear, 1.5-2.4 mm. long, 1-nerved; second glume similar, 2.2-3.4 mm. long; fertile lemma 2.5-3.4 mm. long, narrowly ovate, strongly keeled, firm, slightly roughened, the marginal nerves short-ciliate on the upper half, slightly bifid at the tip, the awn 7-11 mm. long, arising between the teeth of the lemma; callus short-ciliate; palea equal to the lemma; rachilla segment slender, half as long as the lemma, bearing a slender rudiment 0.5-1.5 mm. long, mostly concealed by the fertile lemma; awn of rudiment 2.0-7.5 mm. long; anthers 3, yellow, 0.5 mm. long. Chromosome number $n = 20$ from Costa Rican material.

Common in open, disturbed areas, cafetales, banana plantations, cacao groves; sea level to 1,300 m. elevation, on both Caribbean and Pacific slopes. Blooming apparently yearlong. Mexico to Paraguay; West Indies.

CHUSQUEA Kunth

REFERENCES: E. G. Camus, *Les Bambusees: Monographie, biologie, culture, principaux usages*, Lechevalier. Paris. Text and Plates. 1913. F. A. McClure, *Genera of bamboos native to the New World*.

(*Gramineae: Bambusoideae*), Smithsonian Contr. Bot. 9:1-148. Smithsonian. Washington, D.C. 1973. Wm. Munro, A monograph of the Bambusaceae, including descriptions of all the species, Trans. Linn. Soc. London 26:1:1-157 + 6 Tab. 1868.

Bamboos of small to moderate stature; rhizomes pachymorphous or occasionally leptomorphous; culms arching, the upper portions often drooping or trailing; branching from middle and upper nodes; internodes solid, rarely with a small irregular lumen by disintegration of the central parenchyma; branching usually with a single large primary branch just above the node, subtended by a fascicle of few-many shorter, foliage-bearing branchlets; primary branch bud sometimes not developing into a branch and remaining concealed by the minor branchlets. Inflorescences terminal on the leafy branchlets, variously open or dense panicles or rarely reduced to a small raceme of few spikelets. Spikelets narrowly ovate, acute or acuminate, sometimes short-awned; glumes much shorter than the spikelet, sometimes rudimentary, nerveless or 1-3-nerved; disarticulation above the glumes, the remainder of the spikelet shed as a unit; sterile lemmas 2, similar, from half as long to nearly as long as the spikelet; fertile lemma ovate, acute or awn-tipped, rounded or flattened on the back, 5-13-nerved; palea about as long as the lemma or slightly exceeding it, usually grooved between the keels, 4-8-nerved; lodicules 3, flat, ovate or spatulate, vasculated, usually ciliate on the upper half; anthers 3, large; ovary beaked or with a short style; stigmas 2.

Chusquea is a large genus of montane bamboos, ranging from Mexico to southern South America. Vegetatively, the plants are usually distinguished by the solid culms and the branching pattern of one large primary branch and numerous small, foliage-bearing branches. The spikelets are rather uniform in structure and, on the rare occasions when the plants are in bloom, furnish good clues to identity. Recently, McClure has segregated the genus *Swallenochloa* for the high-altitude forms with fewer, more strict branches and an irregular lumen in the internodes. The distinctions are not sharp, and our chromosome studies have indicated that both genera have a haploid chromosome number of $n = 20$, a somewhat unusual number in the bamboos. Some species of *Bambusa*, subgenus *Guadua* may also have solid or nearly solid internodes at times. They can usually be differentiated by the possession of branch thorns and by their low-altitude habitats.

Chusquea is an extremely complex genus, and we are not yet able to name all collections. The treatment offered here is tentative. A few distinctive, but as yet unnamed, populations are briefly discussed at the end of this generic treatment. (Bambusoideae: Chusqueae.)

KEY TO SPECIES OF *Chusquea*

- 1a. Culms of mature plants 1 cm. or less thick 2
- 1b. Culms of mature plants usually 2-5 cm. thick 4

- 2a. Leaf blades 7.5-17 cm. long, 16-23 mm. wide, ovate, 3-5 $\times$ longer than wide
C. virgata
- 2b. Leaf blades 1-9 cm. long, 2-12 mm. wide, ovate, 5.7-7 $\times$ longer than wide . 3
- 3a. Leaf blades on foliage-bearing branchlets 1-2.5 cm. long, 2-4 mm. wide; base of leaf blades with tuft of woolly hairs on one side of midrib on abaxial surface; internodes of culms smooth *C. coronalis*
- 3b. Leaf blades on foliage-bearing branchlets 5-9 cm. long, 8-14 mm. wide; base of leaf blades woolly on both sides of midrib on abaxial surface; internodes of culms scabrous *C. simpliciflora*
- 4a. Leafy branches interspersed with thin, curly, leafless, fibrillar branchlets, up to 10 cm. long *C. scabra*
- 4b. Leafy branchlets not interspersed with fibrillar branchlets 5
- 5a. Lowermost 10-20 nodes of the culms bearing circlets of short, protruding root thorns up to 10 mm. long *C. pittieri*
- 5b. Root thorns absent, lower nodes of culms sometimes with soft, drooping adventitious roots 6
- 6a. Ligule 1.5 mm. or less long; leaf blades narrow, 14-51 $\times$ longer than wide, not conspicuously tessellate 7
- 6b. Ligule 2-10 mm. long; leaf blades 6-14 $\times$ longer than wide, strongly tessellate 8
- 7a. Leaf blades 7-12 mm. wide, 14-32 $\times$ longer than wide *C. longifolia*
- 7b. Leaf blades 4.5-7 mm. wide, 23-51 $\times$ longer than wide *C. meyeriana*
- 8a. Leaf blades 10-14 $\times$ longer than wide, margins not conspicuously white-banded; texture thin; base of blade tapering to the pseudopetiole; widespread in the mountains *C. tonduzii*
- 8b. Leaf blades 6-9 $\times$ longer than wide, base rounded or subcordate; margins conspicuously white-banded; Poás, Irazú, Turrialba .. *Swallenochloa vulcanalis*

Chusquea coronalis Sods. & Cald., Brittonia 30:158. 1978.
 Figure 40.

Caespitose in small clumps of 2-3 culms; rhizomes pachymorphous; culms to 3-5 m. tall; internodes ca. 1 cm. thick, smooth, cylindrical, solid; sheath girdle retrorsely bearded; primary branch buds usually developing, the primary branches slender, up to 70 cm. long; foliage-bearing branchlets on the main culm or on the primary branches numerous, up to 70 per node of the primary culm or in smaller fascicles on the branches; foliage-bearing branchlets very slender, simple, 5-11 (-17) cm. long, in blooming specimens with 1-2 leaves; nodes minutely retrorsely bearded; sheath glabrous; ligule minute; blades flat, 1-2.5 cm. long, 2-4 mm. wide, glabrous except for a minute tuft of hairs on one side of the midrib on the abaxial surface just above the base. Inflorescences terminal on the foliage-bearing branchlets; peduncle slender, exerted up to 4 cm.; inflorescence a raceme or slender simple panicle, 2-4 (6) cm. long, ca. 5 mm. wide, with a few appressed branches bearing 1-3 spikelets each, most of the spikelets borne racemously on the rachis; pedicels ascending or appressed, slender, up to 7 mm. long; spikelets usually 2-10 per panicle, rarely up to 30, appressed to the rachis. Spikelets dorsally compressed, stramineous or purplish, papery, 5.0-5.5 mm. long; glumes reduced to a minute cupule, 0.2-0.3 mm. long at the tip of the pedicel; disarticulation above the glumes, the remainder of the spikelet falling as a unit; first sterile lemma 2.3-2.7 mm. long, ovate ca. 2:1, blunt, 1-nerved, ciliolate near the tip; second sterile lemma similar, 2.7-3.0 mm. long;

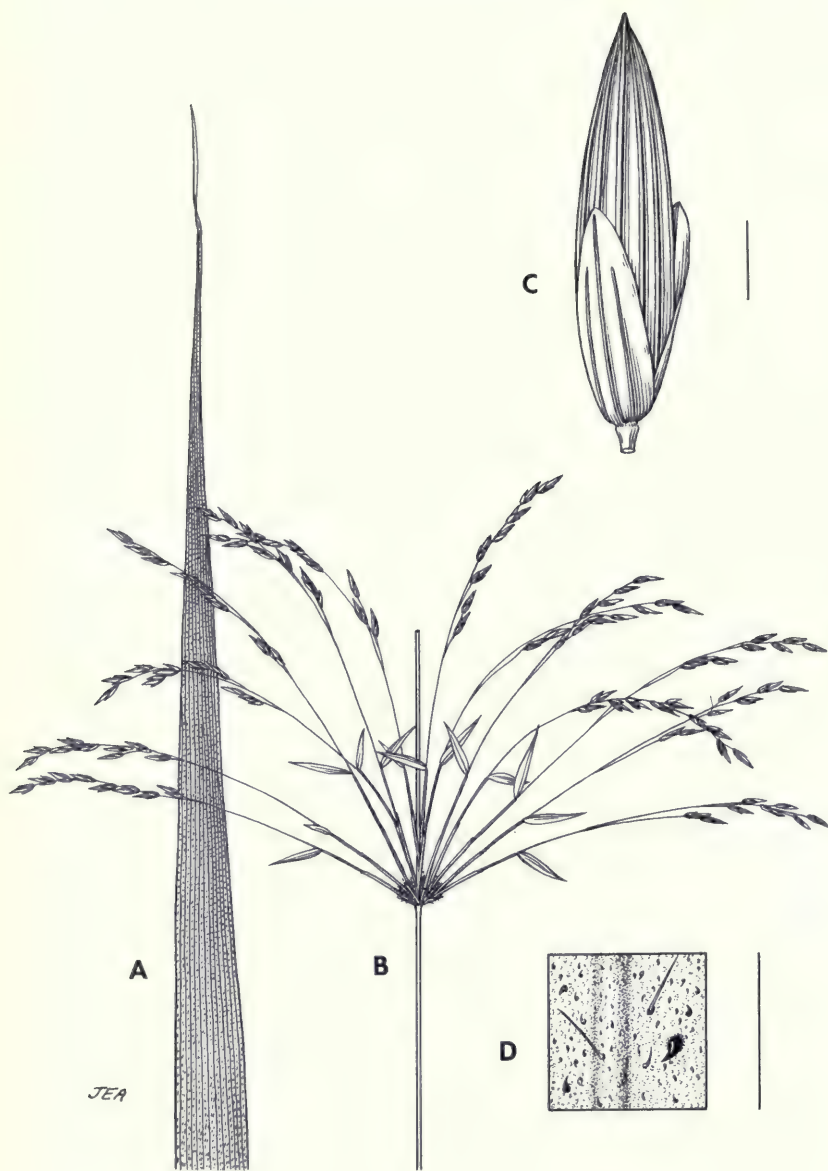


FIG. 40. *Chusquea coronalis*. A, culm sheath; B, inflorescence; C, spikelet; D, surface of culm sheaths, square is 0.1 mm.

fertile floret dorsally compressed, the lemma 5.0-5.1 mm. long, ovate, acute, strongly ridged and grooved, 8-9-nerved, ciliate near the tip; palea about equal or slightly longer, 4-nerved, bidentate at the tip, ciliate on the upper margins, grooved between the keels; lodicules 3, flat, vasculated, long-ciliate at the tip; anthers 3, yellow, 3.2-3.5 mm. long; style very short; stigmas 2. The description was taken from the specimen cited below.

Costa Rica: Prov. San José, Canyon of Río Jericó, 2 km. NW of Río Conejo, 84° 5' W, 9° 48' N, elevation 1,200 m., 11 June 1976, *Pohl & Pinette 13209*, ISC, US, F, CR. The following specimen appears to be the same species, but is in vegetative condition. Foliage leaves are larger and more numerous, but have the same pubescence pattern. Primary culm sheaths are densely splotched with purple and are strongly hispid with appressed, papillose-based rigid hairs. Some of the larger branchlets have enlarged foliage leaf blades on the branch axis, as well as clusters of small branchlets bearing small foliage leaves at the nodes. Prov. San José, Forest valley of Río Alumbre, near Río Conejo, elevation ca. 1,200 m., culms 10-15 m. long, arching and drooping, solid, forming dense drooping veils of foliage, 6 September 1968, *Pohl & Davidse 11054*, ISC, US, F, CR.

This species is similar to *C. simpliciflora* Munro, but differs from it in the shorter spikelets with much smaller glumes, the blunt sterile lemmas, strongly ridged and grooved fertile lemma, and the more numerous spikelets. From *C. heydei* Hitchc., it differs in its much shorter spikelets with smaller glumes, in the obtuse one-nerved sterile lemmas, those of *C. heydei* being three-nerved, and in its strict, narrow panicle with short-pedicellate spikelets.

***Chusquea longifolia* Swallen, J. Wash. Acad. Sci. 30:210. 1940.**

Caespitose bamboo in large, dense clumps; colonial, forming large stands; culms to 10 m. or more long, arching and drooping; internodes up to 3 cm. thick, cylindrical, smooth or scaberulous, solid; culm sheath (one specimen seen) 12 cm. long; ligule thick, straight ca. 2 mm. long; blade erect, as wide as the sheath apex, 13 cm. long, 3.5 cm. wide, acuminate, awn-tipped; foliage-bearing branches numerous in a dense fascicle, up to 60 cm. long, including the inflorescence when present; primary branch bud usually developing into a branch; leaf sheaths glabrous except for the ciliate overlapping margin; external ligule evident; sheath apex with rounded stiff auricles; internal ligule 1.0-1.5 mm. long, membranaceous; leaf blades glabrous or with appressed or velvety pubescence beneath, mostly 14-27 cm. long, 7-12 mm. wide, the length usually 14-32 × the width. Inflorescence a slender dense panicle, its base usually included in the uppermost sheath; panicle 8-17 cm. long, 1.0-1.5 cm. wide; branches short, erect, scabrous on the angles, bearing spikelets to the base. Spikelets stramineous or purplish, borne on short, erect pedicels. Spikelets 10-15.7 mm. long, including the awn of the fertile lemma, subcylindric, purple, fading to stramineous, disarticulating above the glumes, the remainder of the spikelet falling as a unit; glumes acute or rounded, usually nerveless; first

glume 1.0-1.3 mm. long; second glume 1.4-1.8 mm. long, first sterile lemma papery, ovate 3.2-4.3:1, 7-9-nerved; second sterile lemma nearly as long as the fertile floret, papery, 8.0-12.7 mm. long, with an awn 1-3 mm. long, ovate 3.2-4.3:1, 7-9-nerved; fertile lemma smooth, stiff, glabrous, dorsally rounded, 9-14 mm. long, including an awn 1.0-1.5 mm. long, ovate 3:1, 7-nerved or sometimes with an additional marginal pair of weak nerves; palea equal to the lemma or slightly exceeding it, 6-7-nerved, rounded to the keels and grooved between them; apex rigidly bidentate; lodicules 3, flat, obovate, acute, vasculated, long-ciliate at the tip; anthers 3, yellow, 5.1-5.4 mm. long; style short; stigmas 2; caryopsis oblong, 9 mm. long.

Seedlings of this species were found in abundance growing on leaf litter in shade on a cliff above the highway 2.5 km. S of the Vara Blanca-Poás intersection in June 1976. They were all less than 10 cm. tall and were derived from dead fruiting plants of this species, as could be determined from the attached spikelet parts. Their leaf blades were ovate ca. 3:1, and the nodes, sheath margins, auricles, and blade surfaces were pubescent. This pubescence is a juvenile feature, not seen in the parent plants.

The following flowering or fruiting specimens were collected from Volcán Poás, and the description was largely drawn from them: *P & D 11507*, *Pohl & Lucas 13100*, *Pohl & Pinette 13217*, *Tonduz 10747* (cited by Swallen). The following flowering or fruiting specimens were obtained along the CIA near La Georgina. Their spikelets are slightly shorter, but are otherwise similar to the Poás material. Leaf blades are usually narrower and may be pubescent: *Pohl & Lucas 13101*, *13112*. The following flowering specimen came from the Zarcero region: Prov. Alajuela, Palmira, elevation 6,000 ft., 18 September 1937, *A. Smith A 412*. The following vegetative specimen was from Hacienda Central, Volcán Turrialba. It is similar to the Talamanca specimens in having pubescent leaf blades: *Pohl & Davidse 10867*.

Middle to high altitudes, Cordillera Central and Cordillera de Talamanca, at elevations of 1,700-3,100 m., mostly below the páramo. According to Swallen, this species ranges from Chiapas, Mexico, to Chiriqui, Panama. Blooming is known in Costa Rica from the years 1896, 1937, 1968, 1974, and 1976. Our first flowering collection, from Poás, was from a solitary flowering culm, and no other flowering was seen at that time. In December 1974, we found a single large clump flowering, ca. 5 km. below the crater of Poás. The 1976 flowering involved large stands flowering gregariously in the Vara Blanca area.

Chusquea meyeriana Ruprecht ex Doell, in Martius, Fl. Brasil. 2:203. 1880. Figure 41.

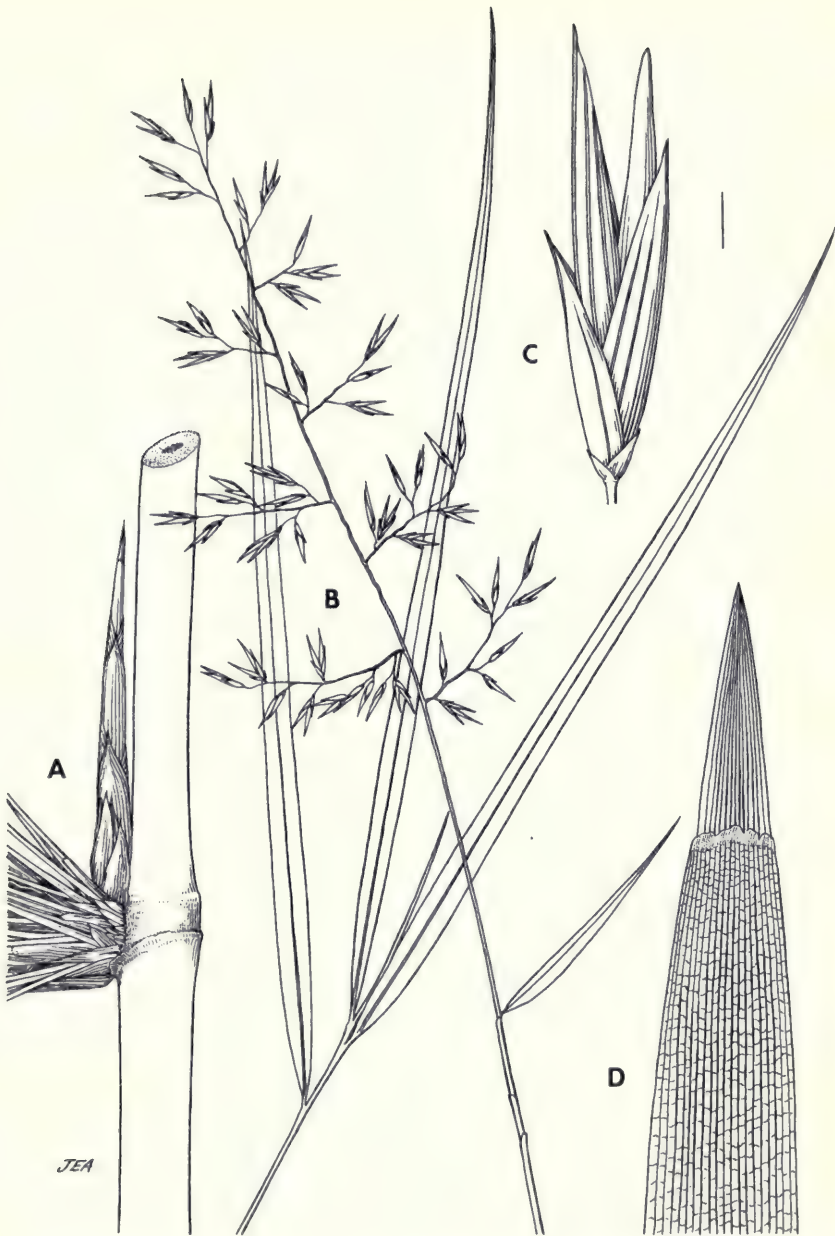


FIG. 41. *Chusquea meyeriana*. A, culm node and branch complement; B, inflorescence and foliage leaves; C, spikelet; D, culm sheath, blade, and ligule.

Caespitose bamboo; culms to 10 m. or more long, arching and drooping; internodes cylindrical, solid, up to 5 cm. thick, the lower nodes sometimes bearing root-thorns; sheath girdle prominent; internodes slightly scaberulous, especially toward the apex; culm sheaths sparsely hispid, especially near the base, the apex with rounded auricles continuous with a stiff ligule up to 5 mm. long; primary culm branch developing or not; foliage-bearing branches 30-60 cm. long, including the inflorescence, if present, very numerous in a dense fascicle; lower internodes of the foliage-bearing branchlets elongated, their sheaths bladeless; leaf blades clustered toward the tips of the branches; internodes puberulent; sheaths glabrous except for the ciliolate overlapping margin; external ligule evident; internal ligule a stiff membrane ca. 1.5 mm. long; one sheath auricle present; leaf blades linear 23-51:1, 14-23 cm. long, 4.5-7.0 mm. wide, sparsely pubescent, sometimes glaucous beneath. Peduncles well exserted; inflorescence an open pyramidal panicle, up to 12 cm. long, about as wide; branches solitary, widely spreading, 2-8 cm. long; rachis, branches, and pedicels angular, scabrous on the angles; pulvini of primary branches evident, puberulent. Spikelets mostly appressed along the primary panicle branches; pedicels slender, somewhat flexuous, 2-7 mm. long. Spikelets stramineous, 7.8-9.5 mm. long, narrowly ovate, acute; glumes reduced, nerveless, the first 0.3-0.8 mm. long, the second 0.5-1.0 mm. long, acute; disarticulation above the glumes, the remainder of the spikelet falling as a unit; sterile lemmas papery, awn-tipped, the first 4.0-6.5 mm. long, ovate ca. 2.5:1, 3-nerved; second sterile lemma similar, 4.8-6.5 mm. long, ovate ca. 3:1, 5-nerved; fertile lemma firmer, 7.2-8.5 mm. long, with a short awn-tip, ovate 2.4-2.7:1, 7-9-nerved; lodicules 3, flat, vasculated, ovate, acute, the upper half ciliate with long stiff hairs, the surface toward the tip with short barbs; the two exterior lodicules much wider than the third; anthers 3, pale yellow, 3.5-5.0 mm. long; style short; stigmas 2; caryopsis not seen.

The above description was compiled from Costa Rican material available to me. The panicle of *Lankester 105* is a reasonably good match for the illustration given by Camus, Monog. Bamb. pl. 50; however, we do not have both fruiting and vegetative material taken from the same stand at the same time. Costa Rican specimens that I have seen are the following: Prov. Cartago, Cascajal, altitude 5,500 ft., year 1919, *C. H. Lankester 105* (flowering), NE of Cascajal, 1,700 m. elevation, 22 December 1974, *Pohl & Lucas 13089* (vegetative); Prov. Puntarenas, heavily wooded slopes above Monteverde, elevation 1,500 m., 8 May 1971, *R. W. Wilbur 14254* (flowering), Forest Preserve, Monteverde, elevation 1,500 m., 20 June 1976, *Pohl & Pinette 13248* (vegetative).

***Chusquea pittieri* Hackel, Oesterr. Bot. Z. 53:153. 1903. Figure 42.**

Caespitose bamboo in open clumps of ca. 20 culms; culms arching and drooping, 10-15 m. long, forming delicate curtains of foliage; internodes cylindrical, glabrous, solid, up to 4 cm. thick, green when young, becoming yellow; lower 20 or more culm nodes bearing a ring of straight projecting root thorns, these up to 10 mm. long; culm sheaths 30-55 cm. long, tapering from the base to a very narrow apex; surface tawny, purple-blotched, or solid purple, scabrous-roughened and with scattered coarse, glassy, papillose-based hispid hairs; ligule thick, rigid, up to 3.5 mm. long, coarsely hispid at the apex; sheath

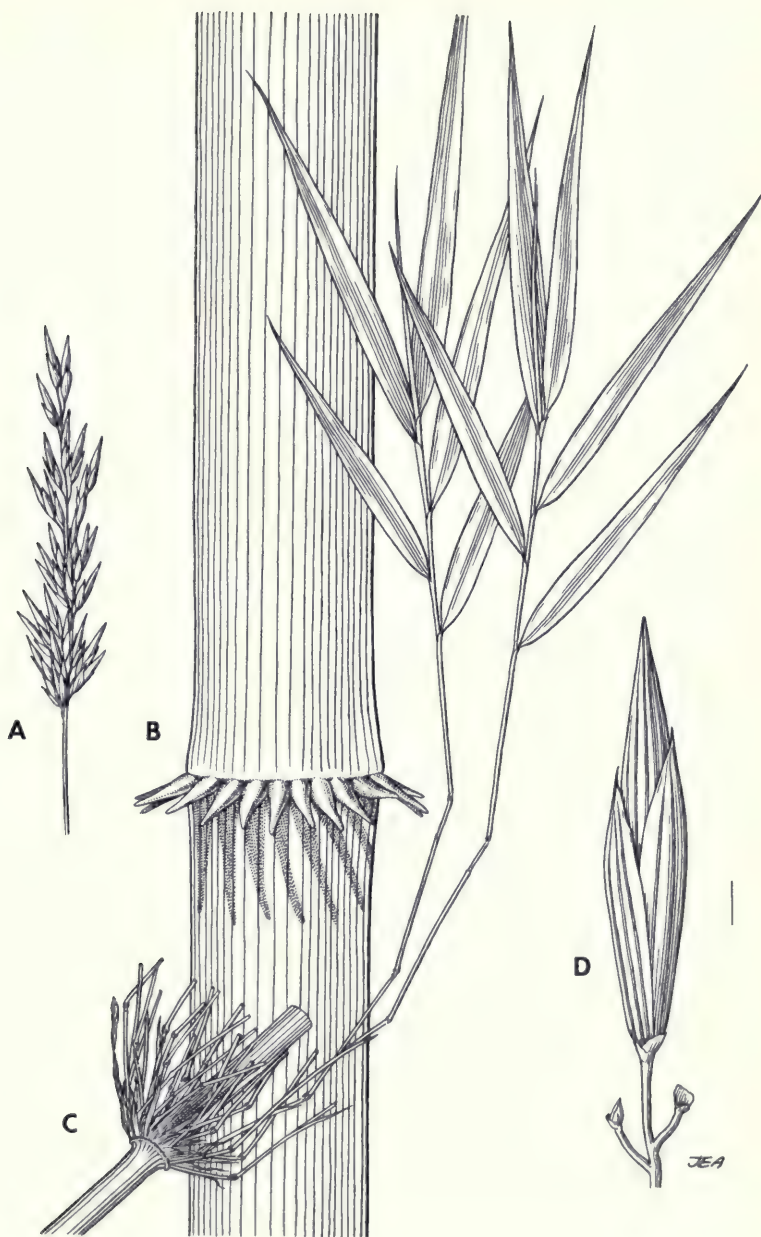


FIG. 42. *Chusquea pittieri*. A, inflorescence; B, culm segment with nodal root thorns; C, node with branch complement; D, spikelet.

blades early deciduous, ca. 15 cm. long, 7-8 mm. wide (1 specimen seen); sheaths deciduous, but sometimes impaled by the root thorns and remaining on the culm; primary branches 1-several from each of the upper nodes; foliage-bearing branchlets numerous, delicate, up to 100 per node, 20-30 cm. long, the base of the fascicle of branchlets sometimes completely encircling smaller branches; lower leaf blades and sheaths of the foliage-bearing branchlets deciduous, the branchlet bearing 3-6 blades toward the tip; sheaths glabrous except for the ciliate overlapping margin; auricles and external ligule ciliate with stiff, glassy hairs up to 3 mm. long; ligule a short erose membrane, ca. 0.5 mm. long; pseudopetiole 1 mm. or less long; leaf blades flat, linear 10-20:1, 6-10 cm. long, 4-7 mm. wide, light green, sometimes slightly glaucous; abaxial surface glabrous except for a dense tuft of short hairs on one side of the midrib at the base (alternating sides on successive leaf blades); adaxial surface with scattered weak hairs. Inflorescence a narrow, rather dense panicle, 4-7 cm. long, up to 2 cm. wide; branches short, ascending, spikelet-bearing to their bases; spikelets overlapping; pedicels short, mostly less than 2 mm. long, scaberulous. Spikelets dorsally compressed, 11-12.3 mm. long, acute; glumes much reduced, rounded or barely acute, nerveless, the first ca. 0.5 mm. long, the second ca. 1.1 mm. long; disarticulation above the glumes, the remainder of the spikelet falling as a unit; sterile lemmas 2, papery, the first 6.4-7.0 mm. long, ovate 2.3:1, 7-nerved, with a minute awn-tip; second sterile lemma similar, ca. 7 mm. long, 5-nerved, awn-tipped; fertile lemma 10.5-12 mm. long, 11-14-nerved; palea slightly longer, 7-8-nerved; apex bidentate; lodicules 3, flat, strongly vasculated, acute, long-ciliate above the middle; ovary with a slender terminal appendage and 2 stigmas; caryopses not seen.

Moist canyons of the volcanoes of the Cordillera Central, from 1,500-2,700 m. elevation. The following collections are known from Costa Rica: Finca San Juan, Volcán Barba, *Pohl & Selva 12298*; Bajos de las Nubes, *Pohl & Lucas 13088*; OK Corral, *Pohl & Lucas 13106*; Rio Reventado between Llano Grande and Tierra Blanca, *Pohl & Lucas 13098*; Copey, *Pohl & Lucas 13140*; Santa Maria de Dota; Quebradillas; Cuestas de los Arrepentidos between San Marcos and Santa Maria de Dota, *Pittier 2249* TYPE in US.

This species is readily identified vegetatively because of the conspicuous root thorns borne on many nodes from the base to the middle of the culm, and even on some of the primary branches. The type specimen, collected in 1890, was in the flowering condition. Several collections by Standley in 1925 also had inflorescences. I have not seen recent bloom. McClure, in the *Flora of Guatemala*, indicates that *C. pittieri* also occurs in Guatemala and Panama.

***Chusquea scabra* Sods. & Cald., Brittonia 30:300. 1978.**

Caespitose bamboo in large, dense clumps, forming large colonies; culms to 10 m. long, 2-3 cm. thick, arching, scrambling through trees, the upper portions pendent; internodes green, scabrous-roughened, not hispid, solid; lower nodes sometimes bearing soft roots up to 5 cm. long; main-culm sheaths scabrous-roughened, more or less purple-spotted; ligule a straight diagonal line, a thick, ciliate membrane 0.3-0.5 mm. long with a few auricular hairs at its ends; culm-sheath blade as wide as the sheath apex, erect, the

adaxial surface scabrous with short, stiff hairs; foliage-bearing branchlets in dense fascicles, ca. 20-30 per node, subtended by conspicuous basal bracts and prophylls; branchlets subequal, stiff, up to 70 cm. long, including inflorescences when present, bearing 2-3 well-developed leaf blades toward the tip and some reduced ones below; leafy branchlets interspersed with numerous slender, curly, fibrillar branches up to 10 cm. long, these bearing reduced bladeless sheaths at their nodes; principal foliage leaf blades flat, 11-15 cm. long, 12-15 mm. wide, ovate 8-10:1, acuminate, scaberulous on both surfaces, especially toward the tip; margins white-banded, scabrous. Blades are glabrous in the populations from the Irazú-Turrialba Massiv, but our collection from El Muñeco has blades sparsely hairy beneath. Internodes of foliage-bearing branchlets glabrous; sheaths glabrous except for the ciliate overlapping margin; sheath auricles erect, rounded at the apex, up to 3 mm. long, ciliate; external ligule coriaceous, up to 1.5 mm. long; pseudopetioles 3-4 mm. long, margined. Inflorescences terminal on leafy branchlets; peduncles usually included in bladeless sheaths; panicles strict, erect, 10-24 cm. long, less than 1 cm. thick, the branches erect, appressed to the rachis, the lower ones up to 8 cm. long, the upper very short, all bearing overlapping spikelets to their bases; rachis, branches, and pedicels angular, scabrous; lateral pedicels usually 3-8 mm. long, appressed. Spikelets numerous, narrowly ovoid, acuminate, awn-tipped, 8.2-10.3 mm. long; glumes scabrous on the keels, awn-tipped, the first 1-nerved, 2.0-3.2 mm. long, 0.7 mm. wide; second glume 3.2-4.1 mm. long, 1.1 mm. wide, 3-4-nerved, the awn up to 1.2 mm. long; disarticulation above the glumes, the remainder of the spikelet falling as a unit; first sterile lemma papery, scaberulous, 4.2-5.6 mm. long, including the awn-tip, ovate 2.0-2.4:1; nerves 5, sometimes with 2 additional weak marginal ones; margins ciliate, tapering abruptly to the awn; second sterile lemma similar, 6.2-8.0 mm. long, 5-7-nerved, ovate 2.5-3.1:1, the awn-tip to 1 mm. long; fertile lemma dorsally flattened, firmer than the sterile lemmas, faintly 7-nerved, 8.0-9.3 mm. long, the palea slightly shorter, its margins rounded to the scabrous keels; apex bidentate; a deep groove present between the keels; lodicules 3, ovate, flat, strongly vasculated, the rounded tip long-ciliate, the margins shorter-ciliate with 1- and 2-celled microhairs; anthers 3, yellow, 4.3-4.5 mm. long; style short, stigmas 2; caryopses not seen. Chromosome number $n = 20$ from Pohl & Pinette 13305.

The following collections of this species are known: Prov. Cartago, Río Coliblanco, 4 km. NE of Capellades, 1,630 m., 4 June 1976, Pohl & Pinette 13305 (blooming), Crossing of Río Aquiares, W of Santa Cruz, 1,570 m., 4 June 1976, Pohl & Pinette 13307 (young bloom), 5 km. NE of Capellades, 1,650 m., 11 June 1973, Pohl & Selva 12888 (vegetative), Valley of Río Sombrero, 2 km. S of El Muñeco, 1,300 m., 7 June 1973, Pohl & Selva 12871 (vegetative).

This species is one of the most easily recognized of the Costa Rican species of *Chusquea* because of the scabrous internodes and the abundant basal fibrillar branchlets at the leaf-bearing nodes. Moist mountain slopes, 1,200-1,600 m. elevation.

Chusquea simpliciflora Munro, Monogr. Bambusaceae, Trans. Linn. Soc. London. 26:1:54, Tab. II. 1868.

Vineline bamboo; rhizomes leptomorphous; culms very elongated, to 25 m. long; internodes less than 1 cm. thick, smooth or usually scabrous with hard points, not hispid; culm sheaths glabrous, purple, tapering to a filiform blade ca. 2 cm. long, its ligule a dense row of short hairs; foliage-bearing branchlets very slender, 20-40 cm. long, up to 50 per node; lower internodes elongated, naked; foliage blades 3-5, clustered toward the tip; sheaths glabrous or puberulent, retrorsely ciliate at the base, ciliate on the overlapping margin; auricles more or less ciliate; external ligule evident; internal ligule 0.5-1.0 mm. long, membranaceous; pseudopetiole 1 mm. or less long; leaf blades thin, 5.5-9 cm. long, 8-14 mm. wide ovate 5.7-7.3:1 flat; abaxial surface with 3 conspicuous, whitened nerves on each side of the midrib, woolly on both sides of the midrib at the base, the remainder glabrous or sparsely appressed hairy; adaxial surface glabrous or very sparsely appressed pubescent, the midrib scabrous. Inflorescence a short raceme of 2-4 spikelets, terminal on short foliage-bearing lateral branchlets; pedicels 1.0-4.5 mm. long, smooth. Spikelets 7.7-10.5 mm. long; glumes vestigial, the first ca. 0.2 mm. long, the second 0.3-0.5 mm. long; remainder of spikelet disarticulating above the glumes and falling as a unit; sterile lemmas 2, similar, faintly 1-3-nerved, glabrous or slightly puberulent at the base, triangular 5-6:1, the first 4.6-5.0 mm. long, the second 4.9-6.2 mm. long; fertile lemma 8.0-9.7 mm. long, faintly 5-7-nerved, ca. 3 × longer than wide, acute; palea similar, slightly longer, faintly 5-nerved, not grooved, bidentate; lodicules 3, ciliate above the middle, acute; anthers 3; style 1; stigmas 2.

None of our Costa Rican specimens is flowering, and the spikelet description has been taken largely from *Shattuck 717*, from the Canal Zone. Munro gives an excellent plate showing flowering material (Tab. II). The following vegetative specimens are from Costa Rica: Prov. San José, Quizarrá, Los Cusingos, elevation 760 m., *Pohl & Lucas 13114*, same site, *Pohl & Pinette 13257*, same site, *A. Skutch s.n.*; 18 km. SW of San Isidro, elevation 800 m., *J. P. Smith 3000*; 10 km. SW of San Isidro, elevation 800 m., *Pohl & Calderón 10061*; 10 km. SW of Santiago de Puriscal, elevation 800 m., *Pohl & Pinette 13286*; Prov. Alajuela, Río Zapote, 6 km. S of Upala, elevation 60 m., *Pohl & Pinette 13229*; Prov. Puntarenas, 2 km. NW of Guacimo, Coto Brus, elevation 350 m., *Pohl & Pinette 13272*.

Plants of this species are scrambling vines that clamber over and cover small trees and canyon walls. The colony on the Puriscal Road (*13286*) is particularly conspicuous, covering the lower parts of a small canyon.

***Chusquea tonduzii* Hackel, Oesterr. Bot. Z. 53:155. 1903. Figure 43.**

Caespitose bamboo in large clumps; rhizomes at least in part leptomorphous, possibly from the burial of culms; culms 5-20 m. long, arching, the upper ends drooping; internodes 1-3 cm. thick, solid, cylindrical, glabrous or appressed-puberulent; nodes enlarged, with an evident sheath girdle and supranodal ridge; lower nodes sometimes with a ring of thin drooping roots; foliage-bearing branches numerous in dense fascicles, individual branches up to 90 cm. long; primary branch bud apparently not developing,



FIG. 43. *Chusquea* species. *C. tonduzii*: A, spikelet; B, inflorescence; *C. virgata*: C, inflorescence.

the branches all of equal size; foliage leaves with sheaths glabrous except for the ciliate overlapping margin; external ligule evident, cartilaginous; internal ligule stiff, membranaceous, mostly 2-5 (9) mm. long, decurrent on the sheath margins; pseudopetioles 1-3 mm. long; leaf blades flat, 9-19 cm. long, 9-18 mm. wide, ovate 10-14:1, olivaceous or yellowish green, the upper surface glabrous, the lower appressed-pubescent with fine hairs or glabrous, tessellate. Inflorescences terminal on foliage-bearing branches; peduncles included or exserted up to 15 cm.; panicles ovoid 2-5:1, mostly 11-19 cm. long, 3-8 cm. wide, the branches mostly solitary or paired, one long and one short, strongly spreading at maturity, the longest branch 3-6 cm. long; spikelets and peduncles purple; peduncles, branches, and pedicels appressed puberulent, the hairs often retrorse; spikelets clustered along the branches, the pedicels short, 0.5-4.0 mm. long, stiff, appressed. Spikelets purple, subcylindrical, sometimes arcuate, acute to acuminate, 6-7 mm. long, firm-textured, glabrous except for minute ciliation on the upper margins of some of the bracts; glumes much reduced, rounded to barely acute at the apex, nerveless, the first 0.3-1.0 mm. long, the second similar, 0.3-1.1 mm. long; disarticulation above the glumes, the remainder of the spikelet falling as a unit; lower 2 lemmas sterile, lacking paleas, the first 3-4 mm. long, narrowly ovate, acuminate or awn-tipped, 3-nerved; second sterile lemma similar but longer, 3.8-5.0 mm. long, broader than the first, acuminate or awn-tipped, 3-, 5-, or 6-nerved; terminal (fertile) floret with a somewhat dorsally flattened lemma, 5.6-6.6 mm. long, acuminate, 5-7-nerved, its lower margins enveloping the base of the palea; palea as long as the lemma or longer (up to 6.8 mm. long), broad, enveloping the flower, rigidly bidentate at the tip, 4-7-nerved; lodicules 3, flat, vasculated, spatulate, the tip with a few short barbs at the tip; anthers 3, yellow, 2.6-3.8 mm. long; ovary with a short style and 2 plumose stigmas. Caryopses not seen on our blooming specimens, but we have found seedlings associated with two blooming colonies, some of them bearing attached spikelet parts. Chromosome number $n = 20$ from specimens from Poás and Turrialba.

This species is common or abundant on the Cordillera de Talamanca, large colonies occurring along the CIA at elevations of 2,400-3,140 m., below the páramo. Gregarious blooming occurred in some colonies in this area in 1966, 1967, and 1968. I have not seen recent bloom (1973-1976) in the same region. Colonies on Volcán Turrialba, east of Hacienda Central, were in massive bloom in 1966 and 1968. The plants die after gregarious flowering. Seedlings were found growing on moss polsters in shade, but not on bare soil or in full sun. Except for their bladeless lower sheaths and pseudopetiolate leaf blades, they resemble other sterile grass seedlings and might easily be missed. The type locality of *C. tonduzii* is the summit of Volcan Poás, and a large population of the species occurs there. Blooming plants were collected there in 1964, 1967, 1968, and 1972. I have not seen recent bloom in the area. No specimens are recorded from Barba or Irazú, but the species should be sought there. *Chusquea tonduzii* is not known outside of Costa Rica.

Chusquea virgata Hack., Oesterr. Bot. Z. 53:156-57. 1903. Figure 43.

Caespitose bamboo in small clumps, the few culms arising from short, pachymorphous rhizomes; culms solid, weak, less than 1 cm. thick (but bases recorded as up to 2 cm.), recorded as being up to 6-7 m. long; scrambling into brush and trees, the ends drooping; internodes cylindrical, glabrous, green or marbled with purple, solid; nodes swollen, with evident sheath girdle and supranodal ridge; primary culm sheath (one example seen) 9.5 cm. long, 25 mm. wide, the apex abruptly rounded to the base of an erect acuminate vestigial blade, ca. 1 cm. long; ligule an erose membrane ca. 1.5 mm. long; outer surface of sheath strongly and closely ridged, glabrous, purplish; inside surface tessellate-veined. Primary branch bud subtended by a row of flattened buds of minor branches; minor branches few, usually ca. 5 per node, up to 50 cm. long, with a few leaves borne toward their tips; primary branch bud sometimes not developing into a branch; when a primary branch is present, it is only slightly larger than the minor branches; sheaths of foliage leaves glabrous; external ligule evident, ca. 0.5 mm. long, sometimes ciliate; internal ligule membranous, ca. 1 mm. long; pseudopetioles flattened, 1-3 mm. long; leaf blades ovate 3.2-5.2:1, rather abruptly acuminate, 7.5-17 cm. long, 16-33 mm. wide, flat, green on both surfaces, glabrous except for a line of short, stiff tan hairs on each side of the midrib just above the base of the blade. Inflorescence a slender virgate panicle, its base mostly included in the uppermost sheath, 9-17 cm. long, 1.0-1.5 cm. wide, the slender appressed branches up to 3 cm. long; pedicels slender, erect, longer than the spikelets, which are set at an angle of ca. 30° to the pedicel. Spikelets linear, falcate, 8.0-9.7 mm. long; glumes very reduced, semicircular, nerveless, their margins overlapping, the first 0.2-0.3 mm. long, the second 0.3-0.5 mm. long; disarticulation above the glumes, the remainder of the spikelet falling as a unit; lower two florets sterile, represented by 2 empty sterile lemmas, their tips diverging from the fertile lemma; first empty lemma 2.8-3.2 mm. long, ca. 2.5 × longer than wide, acute; second empty lemma 3.4-4.2 mm. long, acuminate; both empty lemmas 1-nerved or faintly 2-3-nerved; third lemma fertile, linear, subcylindrical, arcuate, acute, its margins covering the palea; surface glabrous; nerves 7, faint; palea as long as the lemma, broadly winged, rounded to the keels, 4-nerved, a deep groove between the keels; rachilla not prolonged behind the palea; lodicules 3, flat, vasculated, broadly spatulate, the tips densely ciliate with long hairs; anther (only 1 seen) 4.5 mm. long; style 1; stigmas 2, no caryopses seen.

This species is apparently endemic to Costa Rica. The type, *Tonduz 7730*, was collected in forests at San Marcos, at an elevation of 1,350 m. The specimen, collected in 1893, was in bloom. The species is widely distributed in central Costa Rica, but appears to be rare. Other blooming specimens were collected from Tarrazú in 1918, La Peña de Zarcero (1938), Tapesco (1940), Río Segundo, Barba (1941), Tapesco (1965), and Frailes (1965). No more recent flowering specimens are known, but we have recently collected vegetative plants from Río Birris near Pacayas. The culms are slender and delicate, and the plants support themselves by clambering in brush and trees.

OTHER NOTABLE CHUSQUEA POPULATIONS IN COSTA RICA

The abundance and complexity of the *Chusquea* populations in Costa Rica make it impossible to identify and classify them all. The popula-

tions on the following list have been observed, either in vegetative or blooming condition, but cannot as yet be assigned to definite taxonomic status. Continued observation may make it possible to resolve their status, particularly if blooming specimens can be obtained.

1. Tapantí population. Large, coarse bamboos with drooping culms to 15 m. long; internodes, main-culm sheaths, and sheaths of lateral branches hispid with irritating hairs. The following vegetative populations are known: Monteverde, *Pohl & Pinette 13246*; Alto de Roble, *Pohl & Lucas 12998*; Río Grande de Orosi, near tunnel portal, *Pohl & Selva 12886*; Volcan Barba, *W. E. Booth 161*.

2. Cariblanco population. This striking species grows on the cliff above the Río Cariblanco, just east of the highway to Puerto Viejo. It bloomed in 1968, and most of the colony subsequently died. The plants are exceptionally large, the solid culms reaching a length of 20 m., with long-decumbent bases. Branching is restricted, with usually 2 equal branches at each node. Sheaths and internodes are scabrous. The ovate, cordate-based blades are exceptionally large for a species of *Chusquea*, 20-37 cm. long and up to 45 mm. wide. The inflorescence is a slender virgate panicle up to 50 cm. long, less than 2 cm. thick. The spikelets are more or less typical of those of *Chusquea*, but the glumes are better developed. In general appearance, it resembles *C. lanceolata* Hitchc. of Guatemala, but differs in branching pattern, inflorescence structure, and details of spikelets and foliage. Lodicules 3, similar to those of other *Chusquea* species. *P. & D. 11023, 11033, 11176, 11267*, and *Pohl & Pinette 13224* are representative of this entity.

Because of the unusual branching pattern exhibited by these plants, Dr. Soderstrom believes that they may represent a new undescribed genus.

3. Tarrazú population. This species occurs abundantly in and on the margins of the forest above the new road on the south side of the Río Tarrazú, southeast of Frailes, at about 1,600 m. elevation. In January 1975, the plants were seedlings in small clumps, but dead plants were not observed. By June 1976, the plants were much larger, with culms up to 1 cm. thick and 3 m. long. The foliage-bearing branchlets were up to 15 per node, and up to 35 cm. long, bearing 7-8 very slender leaf blades at the tip. The leaf blades are linear, flat, 14-16 cm. long, the length ca. 20 times the width, and bear a woolly patch on one side of the midrib on the abaxial side at the base. The deciduous culm sheaths are purple, glabrous, and rounded to a rudimentary blade. *Pohl & Lucas 13143* and *Pohl & Pinette 13211* are representative.

CINNA Linnaeus

Caespitose perennials; inflorescence a panicle; spikelets laterally compressed, 1-flowered, disarticulating below the glumes; glumes equal, 3-nerved, longer than the floret; lemma usually short-awned from just below the tip, faintly nerved; keels of palea very close together, the minute abortive rachilla segment partially hidden in the groove between them. (Pooideae: Agrostideae.)

Cinna poaeformis (H.B.K.) Scribn. & Merr., U.S.D.A. Div. Agrost. Bull. 24:21. 1901. *Deyeuxia poaeformis* H.B.K., Nov. Gen. & Sp. 1:146. 1816. Figure 44.

Tall, succulent perennial, forming dense clumps; culms erect, 90-150 cm. tall, unbranched, 3-6 mm. thick, hollow, ridged, glabrous; nodes dark colored, contracted; leaves numerous, the basal ones bladeless; leaf sheaths mostly overlapping, glabrous, ridged, often purplish; ligules 1.5-15.0 mm. long, the upper ones much longer than the lower, brownish or purplish, membranaceous, lacerate; leaf blades flat, 5-35 cm. long, 5-15 mm. wide, glabrous. Peduncle up to 20 cm. long, glabrous; panicles solitary, terminal, lax, 15-45 cm. long, often nodding, very open, the long branches naked, spikelet-bearing only near the tips, borne in verticils; spikelets borne in dense clusters near the tips of the branches, mostly short-pedicellate, the branches and pedicels scabrous. Spikelets strongly laterally compressed, the glumes keeled, equal, 3-nerved, 2.5-3.2 mm. long, lanceolate as folded, scabrous on keel, nerves, and sometimes internerves; floret 1; lemma narrowly ovate, faintly (5?)-nerved, glabrous or scabrid near the tip, usually awnless or with a short straight awn, up to 0.3 mm. long, attached just below the tip; palea nearly as long as the lemma, broad, the 2 keels very close together, the minute rachilla segment held in the groove, ca. 0.3 mm. long; anthers 3, ca. 1 mm. long, tan. Chromosome number $n = 14$ from a Costa Rica specimen.

Brushy or forested moist slopes; páramos, 2,800-3,400 m. elevation; Irazú, Asunción, Buena Vista, Chirripó. Blooming apparently year-long. Mexico to Colombia, Venezuela, and Peru.

COELORACHIS Brongniart

REFERENCE: W. D. Clayton, *Coelorachis* and *Rhytachne*: A study in numerical taxonomy, Kew Bull. 24:309-314. 1970.

Caespitose perennial grasses, the stems branched above and bearing terminal and axillary cylindrical rames, one on each peduncle. Spikelets paired, awnless, one sessile and one pedicellate, both fitting closely against the rachis; rames disarticulating at maturity into individual internodes, each with an attached spikelet pair; rachis internodes thick, cylindrical, hollow, slightly widened upward, truncate; base of internode with a short rounded projection that fits into the hollow apex of the internode below. Spikelets dorsally compressed. Sessile spikelets: First glume coriaceous, elliptic-oblong, flattened, ca. 6-nerved, broadly winged on the upper margins and deeply notched at the midline; inner surface of the glume bearing 2 narrow flanges that converge toward the apical notch and clasp the margins of the second glume; second glume shorter and narrower than the first, narrowly ovate, acute, keeled, 3-nerved; lower (sterile) lemma nearly as long as the first glume, nerveless, hyaline, ovate; lemma of upper (fertile) floret



FIG. 44. *Cinna poaeformis*. A, spikelet; B, floret with rachilla; C, panicle.

keeled, 3-nerved, stiffish, its palea nearly as long; lodicules 2, truncate; anthers 3; style branches naked at the base. Pedicellate spikelets: Similar to the sessile ones but smaller; pedicels thick, dorsally flattened, as long as the rachis joint or longer and fitting closely against it; first glume similar to that of the sessile spikelet; second glume 3-nerved, more strongly keeled than that of the sessile spikelet; winged at the tip, sterile lemma, fertile lemma and its palea well-developed; lodicules 2; anthers 3; stigmas well-developed.

Coelorachis is distributed widely in warmer parts of both eastern and western hemispheres. The genus is most closely related to *Rhytachne*, *Rottboellia*, and *Eremochloa*. Our species have usually been assigned to the genus *Manisuris*. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Coelorachis*

- 1a. Axillary inflorescences arising singly from each upper leaf sheath; rames up to 5 mm. thick; rachis internodes at least 3.5 mm. long *C. ramosa*
- 1b. Axillary inflorescences several from each upper leaf sheath; rames less than 2 mm. thick; rachis internodes less than 3 mm. long *C. aurita*

Coelorachis aurita (Steud.) A. Camus, Ann. Soc. Linn. Lyon 68:197. 1922. *Rottboellia aurita* Steud., Syn. Pl. Glum. 1:361. 1854. *Manisuris aurita* (Steud.) Kuntze, Rev. Gen. Pl. 3:356. 1898. Figure 45.

Perennial, caespitose in dense clumps; culms erect, 100-250 cm. tall, branching from the middle and upper nodes; internodes glabrous, grooved on side toward the branch, 3-7 mm. thick, mostly solid and filled with pith; nodes dark, contracted; prophylla concealed, 3-7 cm. long; foliage clustered toward the base of the culms; sheaths glabrous, the lower ones overlapping, keeled, the upper shorter than the internodes; lower leaf blades elongated, keeled and mostly folded, up to 5 mm. wide, the upper much shorter; ligule a ciliate membrane, 0.6-0.7 mm. long. Peduncles numerous, terminal and axillary, several of different lengths arising from one leaf axil, mostly included in bladeless sheaths; rame solitary on each peduncle, 4-9 cm. long, narrowly cylindrical, 1.5-2.0 mm. thick. Sessile spikelets: First glume 3.7-4.7 mm. long, oblong, rounded on the back, faintly pitted in rows between the 5-6 rather faint nerves; the margins winged, especially near the truncate, 2-lobed apex; second glume keeled, boat-shaped, 3-nerved, scabrid on the keel, 2.9-3.8 mm. long; lower (sterile) lemma 2.5-3.1 mm. long, ovate, acute, thin and nerveless; upper (fertile) lemma 2.3-2.8 mm. long, ovate, acute, slightly keeled, nerveless; palea 1.9-2.5 mm. long, truncate, nerveless; anthers 3, purple, 0.8-1.5 mm. long. Rachis internodes and pedicels thick, the internode 2.0-2.7 mm. long, the pedicel similar but longer, and with a thin triangular wing at the apex on the side away from the sessile spikelet. Pedicellate spikelets: Similar to the sessile ones, but tending to be slightly asymmetric, 2.3-4.3 mm. long; first glume 3-5-nerved; second glume 2.4-4.0 mm. long, 1-3-nerved, ovate, acute, keeled; lower lemma 1.8-3.0 mm. long; upper lemma 1.8-2.3 mm. long; palea ca. 1.5 mm. long; flower present in our specimens, with 3 anthers and ovary with 2 stigmas. Chromosome number $n = 9$ from a Costa Rican specimen.

This species is known in Costa Rica only from Cañas Gordas, where it was collected by Pittier. We found it also in the same locality, growing in a marsh in a large sinkhole between Cañas Gordas and Agua

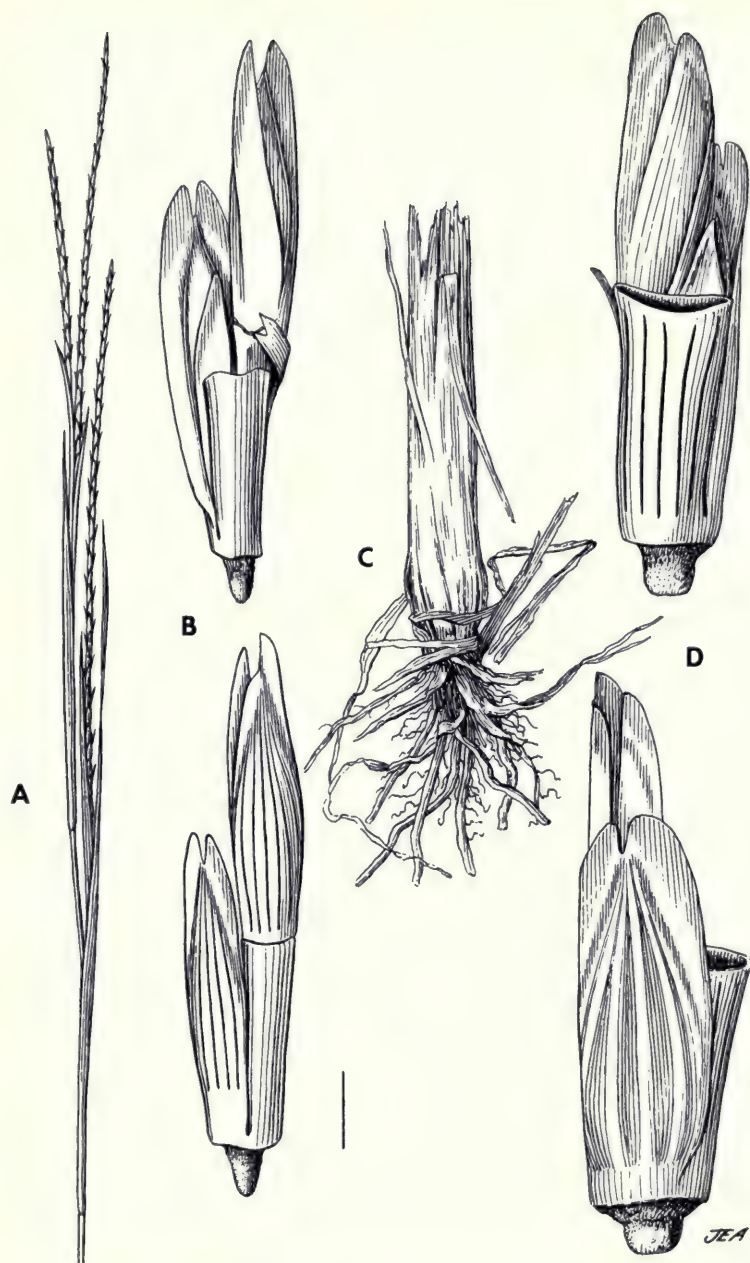


FIG. 45. *Coelorachis* species. *C. aurita*: A, inflorescence; B, a spikelet pair, two views; C, culm base; *C. ramosa*: D, spikelet pair, two views.

Buena. July to October. Honduras, Costa Rica and Panama to Bolivia and Argentina.

Coelorachis ramosa (Fourn.) Nash, N. Amer. Fl. 17:86. 1909. *Apogonia ramosa* Fourn., Mex. Pl. II:63. 1881. *Rottboellia aurita* ssp. *stigmosa* Hack. in DC., Monogr. Phan. 6:311. 1889. *Manisuris ramosa* (Fourn.) Hitchc., Proc. Biol. Soc. Wash. 40:88. 1927.

Densely caespitose perennial; culms 75-125 cm. tall, 1-3 mm. thick, solid, pithy, glabrous, erect, branching from the middle and upper nodes; prophylla prominent, up to 10 cm. long; nodes dark, constricted; herbage and stems often purplish; sheaths shorter than the internodes, keeled, glabrous; ligule a minutely ciliate membrane, 0.5-1.0 mm. long; lower blades crowded, up to 60 cm. long and 7 mm. wide; upper blades much smaller. Inflorescences terminal and axillary from the upper culm nodes, the terminal one 7-13 cm. long and ca. 5 mm. thick, the axillary ones shorter; rame solitary, cylindrical, the spikelets and rachis internodes fitting closely together; rachis internodes thick, hollow, striate on the outer surface, 3.5-4.5 mm. long. Sessile spikelet 4.0-5.5 mm. long; first glume elliptic-oblong, coriaceous, ca. 6-nerved, slightly convex on the back, the marginal wings broadened toward the apex and deeply notched at the midrib, often purplish; back of the glume with rows of shallow pits between the nerves; second glume 3.5-4.5 mm. long, keeled, boat-shaped, 3-nerved; lower (sterile) lemma 3.0-4.0 mm. long, ovate, acute, nerveless; upper (fertile) floret with an ovate, acute, nerveless lemma 3.0-3.5 mm. long; palea 2.5-3.4 mm. long, nerveless; anthers 3, ca. 1.2 mm. long, purple. Pedicels thick, appressed to the rachis, with a thin triangular wing on the side of the apex away from the sessile spikelet; pedicellate spikelets similar to the sessile ones but shorter, 3.5-4.5 mm. long, tending to be more asymmetric than the sessile ones; sterile lemma and fertile lemma 2.4-2.7 mm. long; palea ca. 2.0 mm. long; anthers 3, 1.1 mm. long; some spikelets with well-developed stamens and pistil, others sterile and empty.

Mexico to Honduras; Colombia. Not yet found in Costa Rica.

COIX Linnaeus

Tall, caespitose, maize-like plants; duration indefinite in the tropics; culms freely branching, bearing from the upper leaf axils numerous slender peduncles, each bearing at its apex a rigid, bony bead that is deciduous at maturity. Spikelets unisexual; pistillate spikelet solitary, borne within the cavity of the bead, along with two slender, tubular sterile spikelets. Peduncle passing through the bead and emerging through the apical ostiole and bearing at its apex several groups of sessile or pedicellate staminate or sterile spikelets in somewhat irregular groupings. Pistillate spikelet gibbous, with a slender beak; first glume, second glume, lower (sterile) lemma, fertile lemma and palea present; stigmas 2, protruding from the mouth of the ostiole at anthesis. Staminate spikelets herbaceous, with two equal glumes concealing the staminate florets; staminate inflorescence deciduous from the bead at maturity; beads deciduous from the apex of the peduncle; caryopsis germinating while confined within the bead.

Coix is a genus of one to several species native to tropical southeastern Asia, but widely cultivated for the beads, and sometimes for forage or grain. The genus has no close relationship to any native American genera. (Panicoideae: Andropogoneae.)

Coix lacryma-jobi L., Sp. Pl. 972. 1753. Figure 46.

Duration indefinite; plants 1-3 m. tall, profusely branching above; peduncles flat, slender, produced in clusters from the axils of the upper leaves; a hard, bony involucre (modified leaf) borne at the tip of each peduncle. Involucres usually subspherical, 6-8 mm. wide, usually very hard, gray or white, shining. Pistillate spikelet one in each involucre, broadly ovoid, filling nearly the entire cavity, with a pronounced apical beak; first and second glumes about equally long, the first enfolding all but the keel of the second, both fleshy and delicate, almost nerveless; sterile lemma, fertile lemma and its palea membranaceous, delicate; lodicules none; 1-3 small rudimentary stamens present near the base of the ovary; stigmas 2, exserted through the ostiole of the bead; 2 sterile tubular rudimentary spikelets also included in the bead, lying parallel along the keel of the second glume and just protruding from the ostiole of the bead. Staminate inflorescence borne on a flattened slender peduncle arising from the base of the bead and passing up through the ostiole, parallel to the rudimentary spikelets, and slightly exserted; staminate inflorescence usually 3-8 cm. long, composed of a varying number of triads of staminate spikelets, each triad of 1 pedicellate and 2 sessile spikelets; staminate spikelets soft-textured, with a blunt first glume, 7-12 mm. long, somewhat winged near the apex, flattened and with 2 lateral flanges which clasp the edges of the boat-shaped, ovate, acute second glume; florets 2, the upper slightly larger than the lower, both slightly shorter than the glumes; lemmas many-nerved, narrowly ovate, acute, glabrous; paleas slightly shorter than the lemmas; anthers 3, yellow, 3-5 mm. long. Chromosome number $n = 10$ from Costa Rican specimens.

Blooming yearlong in moist habitats, possibly seasonal elsewhere. Low and medium altitudes, on both Pacific and Caribbean slopes.

The hard gray or white beads that contain the pistillate spikelets are frequently used in making necklaces and as rosary beads. Certain strains of this species, which have soft beads, are sometimes used as a source of grain under the common name of *Trigo adlay*. Common name of the ordinary strains is *Lagrimas de San Pedro*, or in English, "Job's tears."

CORTADERIA Stapf

REFERENCES: H. J. Conert, *Die Systematik und Anatomie der Arundineae*, pp. 1-208. J. Cramer. Weinheim. 1961. H. E. Conner, *Breeding systems in New Zealand grasses. V. Naturalized species of Cortaderia*, New Zealand J. Bot. 3:17-23. 1965.

Tall, vigorous dioecious perennial grasses, forming large dense clumps. Panicles large, plummy because of the numerous long silky hairs borne on the lemmas. Spikelets laterally compressed, wedge-shaped; florets 2-9, all alike or the uppermost much reduced and sterile; disarticulation above the glumes and near the base of each rachilla segment, the rachilla forming a stipe or callus below the detached floret; glumes subequal, 1-nerved, linear-lanceolate, with usually excurrent midrib, pointed or slightly rounded or bifid at the apex, translucent to light brown or purplish, nearly as long as the entire spikelet; lemmas green, purplish, or whitish and translucent, little shorter than the spikelet,



FIG. 46. *Coix lacryma-jobi*. Inflorescence, showing beads and protruding staminate inflorescences.

3-5-nerved or sometimes 7-nerved at the base, either linear-lanceolate, with a long narrow tapering apex terminating in an awn, or short and ovate, with a deeply bifid apex terminating in 2 awned lateral teeth, the awn flat and somewhat twisted, arising from the cleft between the teeth; backs of the papery lemmas bearing numerous long, silky, white hairs 3-10 mm. long on the lower third (staminate spikelets less hairy), midnerve of lemmas always continuous to the tip, the lateral nerves usually extending to the upper third; palea one-third to one-half as long as undivided lemmas, or reaching as far as the insertion of the awn in cleft lemmas, 2-nerved, truncate or 2-toothed, hairy or scabrid between the nerves, sometimes long-hairy on the margins; callus or stipe of the florets bearded with short silky hairs; lodicules 2, wedge-shaped, flat, ciliate at the tip; pistillate flowers with 2 terminal styles naked at their bases, their stigmas spreading laterally from the floret; pistillate flowers with sterile staminodes; staminate flowers with 3 large anthers and rudimentary ovary.

Measurements quoted are taken from Costa Rican specimens and may not agree entirely with those given by Conert. The genus is closely related to *Gynerium*, *Arundo*, and *Phragmites*. Species about 20, in Central and South America and New Zealand. (Arundinoideae: Arundineae.)

KEY TO SPECIES OF *Cortaderia*

- 1a. Lemma deeply bifid at the apex, awn arising between conspicuous, awned lateral teeth 3.0-4.5 mm. long *C. haplotricha*
- 1b. Lemma tapering gradually into awn; lateral teeth of awn minute or absent 2
 - 2a. Panicles silvery white, very plummy, hairs of lemmas 8-10 mm. long; florets 8-9; pistillate flowers lacking rudimentary stamens; cultivated ornamentals
C. selloana
 - 2b. Panicles brownish or purplish; hairs of the lemmas usually 3-5 mm. long; florets 2-3; pistillate flowers with rudimentary stamens; wild plants of paramos at high elevations *C. bifida*

Cortaderia bifida Pilger, Bot. Jahrb. 37:374. 1906. Figure 47.

Tall, stout perennial; culms erect, to 250 cm. tall; clumps large, with very numerous arching basal blades; basal sheaths often closely overlapping, chartaceous, inflated, carinate, persistent, finally breaking down into curly fibers, glabrous, the margins membranous; ligule a dense row of silky white hairs, 1.5-2.0 mm. long; blades firm, to 1 m. long, 4-7 mm. wide, glabrous beneath, upper surface above the ligule appressed-hairy or glabrous, margins silky-ciliate near the base, strongly scabrous toward the tip. Panicles solitary, terminal, 25-35 cm. long, rather narrow, 6-20 cm. wide, dense to quite loose and open. Spikelets laterally compressed, wedge-shaped, 10-13 mm. long; first glume 8.0-11.5 mm. long, narrowly lanceolate; second glume 9.5-11.0 mm. long, narrowly lanceolate; florets usually 2-3, disarticulating with a bearded rachilla stipe up to 1 mm. long below the lemma; lemmas ca. 8 mm. long, narrowly ovate, 3-nerved, sometimes with a very faint additional pair near the base; apical teeth minute or absent; awn 4-8 mm. long; lower third of lemma bearing white, silky hairs 4-5.5 mm. long, the keels scabrous; flowers of our specimens functionally pistillate, with sterile abortive anthers. The Costa Rican specimens have developing caryopses.

Conert (1961) reported only the type specimen of this species from

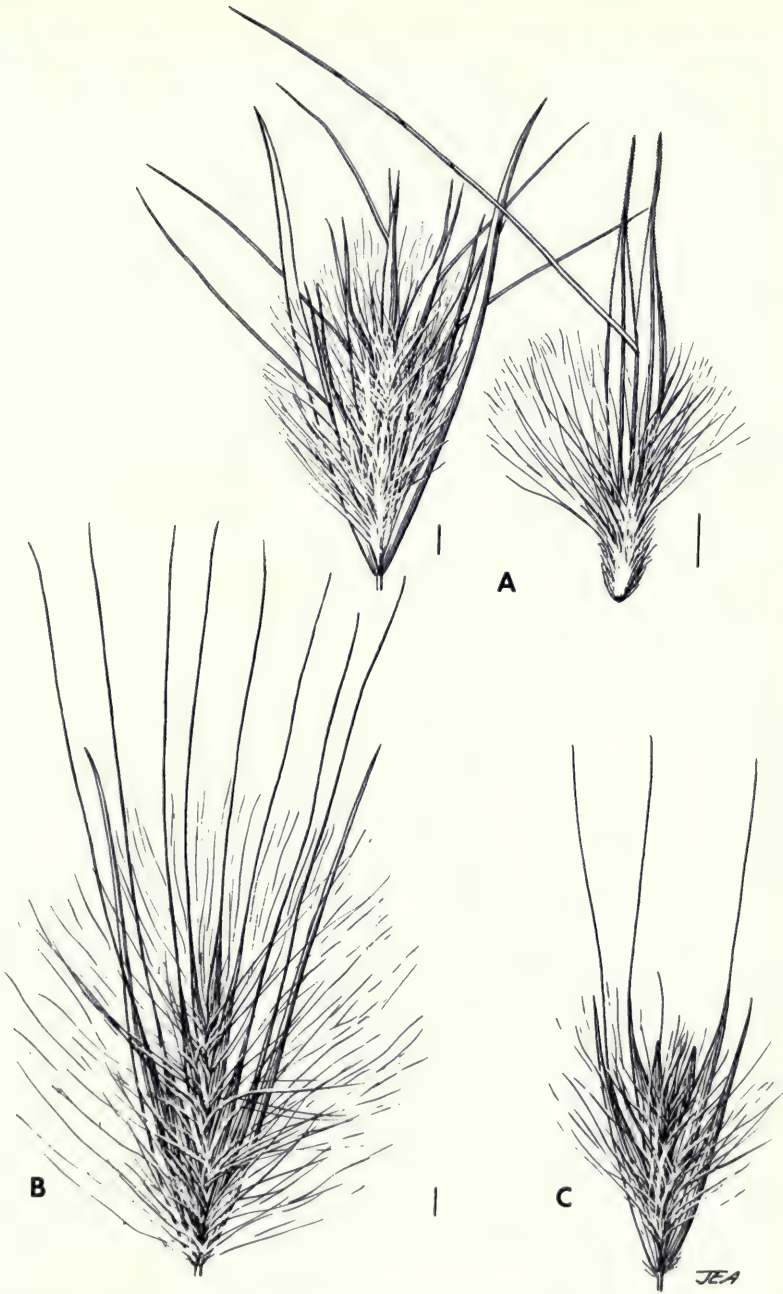


FIG. 47. *Cortaderia* species. *C. haplotricha*: A, spikelet and a single floret; *C. seloana*: B, spikelet; *C. bifida*: C, spikelet.

Peru. This specimen was pistillate, and no staminate plants were known to him. We have never seen staminate plants of *C. bifida* or *C. haplotricha* in Costa Rica, although we have searched for them. Quite probably, these species are apomictic. Conner (1965) has reported the occurrence of apomixis in the South American species, *C. atacamensis*. Conert has identified our specimens, and his determinations have been followed, although our plants differ in some minor respects from his descriptions, which are based upon South American material. Such differences might be expected in apomictic species.

Cortaderia bifida has not previously been reported from Central America. It is rare to occasional, occurring on the upper cinder slopes of Irazú and Turrialba and on páramos of the Cerro de la Muerte and Cerro Chirripó, at elevations from 2,500 to 3,300 m. April to September.

Cortaderia haplotricha (Pilger) Conert, Systematik und Anatomie der Arundineae 102. 1961. *Danthonia haplotricha* Pilger, Bot. Jahrb. 25:715. 1898. Figure 47.

Caespitose perennial, forming large tussocks; up to 1 m. tall; culms ca. 5 mm. thick, hollow, thick-walled; nodes glabrous, not prominent; basal leaves numerous, stiffly erect; sheaths mostly overlapping, silky-hairy on upper margins, slightly so below the collar, breaking down into curly fibers when old; blades up to 80 cm. long, 4-5 mm. wide, glabrous below, scabrous on the margins, upper surface and margins densely silky for 1-2 cm. above the ligule; ligule a dense row of silky hairs, 0.5-1 mm. long; peduncle included on our specimens; panicle up to 30 cm. long, often purplish; spikelets laterally compressed, V-shaped; glumes narrowly lanceolate, acuminate, purplish, 1-nerved, 13-13.5 mm. long; florets 4-5; lemmas 8-10 mm. long, including the bearded basal rachilla stipe, narrowly ovate, 7-nerved, the apex 2-cleft, the lateral teeth 3-4.5 mm. long, tapering into short awns; awn inserted between the teeth, flat, twisted, geniculate, 9-12 mm. long; lower third of the lemma bearing numerous long silky hairs 4 mm. long; palea ca. 4.5 mm. long, ciliate on the lower margins with hairs 2 mm. long; flower pistillate, with abortive anthers 1.2-1.5 mm. long, yellow; lodicules 0.7 mm. long, flat, spatulate.

This species occurs on the páramos of Asunción, Buena Vista, and Chirripó Grande. The plants occur scattered on the páramo, at elevations of 3,260-3,800 m. Plants have been seen with panicles from July to December. *Cortaderia haplotricha* has not been previously recorded from Central America, but was previously known from Colombia, where both pistillate and staminate plants have been collected. Previous publications on Central American grasses have credited *C. nitida* (H.B.K.) Pilger to Costa Rica and Panama. Conert does not indicate this species occurs in Central America.

Cortaderia selloana (Schult.) Aschers. & Graebner, Syn. Mit-

teleurop. Fl. 2:325. 1900. *Arundo selloana* Schult., Mant. III (Add. 1):605. 1827. Figure 47.

Tall, stout perennial, forming large circular clumps; basal leaves prominent, arching and drooping; culms up to 3 m. tall, nearly leafless on upper portions; sheaths glabrous; ligule a dense row of white hairs, 1.5-2 mm. long; blades 1-2 m. long, 6-10 mm. wide, glabrous; midrib protruding below, yellow; blades flat or folded, very scabrous on the margins; auricular hairs present; peduncle solid, 5-8 mm. thick; inflorescence a rather dense, very plummy panicle, 70 cm. or more long in well-developed plants, pyramidal, to 25 cm. wide, shining, silvery white; branches in dense clusters. Spikelets densely crowded, laterally compressed, 15-25 mm. long; glumes 15-25 mm. long, lance-attenuate; florets 7-9; lemmas ca. 10 mm. long, narrowly lanceolate, 3-nerved, tapering gradually into an awn ca. 10 mm. long, without evident lateral teeth, the back bearing long hairs almost to the apex; hairs on lower parts of the back up to 10 mm. long; basal stipe of floret bearded; palea 4.5-5.5 mm. long, scabrid on the keels; flowers pistillate, without rudimentary stamens (in Costa Rican cultivated specimens; Conert reports staminate plants from South America). Chromosome number $n = 36$ (Conner, 1965).

This striking South American species is sparingly cultivated for ornament around San José. I have seen it in Curridabat and the city itself.

CRYPTOCHLOA Swallen

REFERENCE: J. R. Swallen, *Cryptochloa*, in Woodson and Schery, Contrib. Fl. Panama VI, Ann. Missouri Bot. Gard. 29:317-322. 1942.

Caespitose perennial grasses; culms unbranched, their lower internodes elongate, the foliage mostly aggregated near the apex; leaves 2-ranked, the blades lying in one plane, forming flat terminal sprays; blades borne on short thick pseudopetioles which serve as pulvini, orienting the blades in a flat plane during the day and folding them face to face at night. Inflorescences several, few-flowered, arising from the axils of the upper leaves, the peduncles concealed. Spikelets unisexual, the terminal and upper ones pistillate, the lower ones usually staminate. Pistillate spikelets: Dorsally compressed, 1-flowered; glumes equal, 3-5-nerved, longer than the solitary floret; floret borne at the tip of a thick, hardened rachilla internode and disarticulating with it; glumes finally deciduous; lemma ovate, acute, dorsally compressed, rigid, faintly 5-nerved, its flat margins incurved and covering the edges of the palea; palea of similar texture, 2-4-nerved, equal to the lemma but broader, enwrapping the caryopsis; lodicules 3, flat, vasculated, truncate; style 1; stigmas 3, exserted at the tip of the lemma. Staminate spikelets: Borne on erect pedicels on lower parts of the inflorescence, few, dorsally compressed, ovate, acute; glumes absent; floret 1; lemma 3-5-nerved; palea about equal to the lemma, 2-nerved; lodicules 3, similar to those of the pistillate spikelets; stamens 3.

A small genus of rain forest grasses of Southern Mexico and Central America and northern South America. Swallen, in describing the genus, indicated, by his interpretations of the spikelets, that he considered it Panicoid; however, the three flat lodicules, which occasionally bear tricellular hairs, and the presence of fusoid cells in the

leaf cross section indicate that it is Bambusoid. (Bambusoideae: Olyroideae.)

KEY TO SPECIES OF *Cryptochloa*

- 1a. Upper leaf blades 12-26 per culm, 2-2.5 cm. long, green; staminate spikelets less than 3 mm. long *C. concinna*
- 1b. Upper leaf blades usually 5-17 per culm, 5-8 cm. long, purple beneath; staminate spikelets 5-6 mm. long *C. granulifera*

Cryptochloa concinna (Hook. f.) Swallen, Ann. Missouri Bot. Gard. 29:320. 1942. *Olyra concinna* Hook. f., Curtis Bot. Mag. 3:52, pl. 7469. 1896. *Raddia concinna* (Hook. f.) Chase, Proc. Biol. Soc. Wash. 21:185. 1908. Figure 48.

Caespitose perennial; plants forming vase-shaped clumps, wider than tall, the culms 20-40 cm. long, arching and spreading from a dense common center, slender and wiry, hollow or solid, retrorsely puberulent in a line below the opening of the sheath above; apex of each internode enlarged, the pulvinus contracted, retrorsely puberulent; lower several internodes much elongated, their leaves with short sheaths and reduced blades; 12-30 leaves crowded on the upper portion of the culm, their sheaths overlapping, the blades oriented in one plane, forming a flat spray during the day, folded face to face during the night; sheaths puberulent on the overlapping edge, keeled near the summit; ligule an erect membrane, truncate, puberulent on the back, 0.2-0.8 mm. long, or the uppermost one to 1.5 mm.; upper leaf blades 18-25 mm. long, 6-8 mm. wide, ovate 2.5-3:1, abruptly acuminate, flat, glabrous, the margins scabrous; pseudopetiole minute, the pulvinus united to the base of the leaf blade. Inflorescences several, from the ultimate leaf axils, the peduncles concealed in the sheaths. Spikelets few, racemose, the terminal ones pistillate, some of the lower ones staminate. Pistillate spikelets: Ovate, 6-7:1, acuminate, 8.4-11.7 mm. long; glumes membranaceous, subequal or the first slightly longer than the second; compression dorsal; first glume with 3 evident nerves and 2 faint marginal ones; second glume similar, both deciduous after the maturity of the spikelet; floret 6.1-6.9 mm. long, borne on a thick, fleshy rachilla internode and deciduous with it; lemma rigid, ivory white when immature, becoming marbled when in fruit, outline ovate 4:1, acuminate, its margins covering the edges of the similar palea; lodicules 3, truncate; style 1, stigmas 2, apically exserted; caryopsis ovate 3:1, blunt, tan, dorsally compressed, the pericarp extremely thin and easily scaling off the seed; embryo ca. one-sixth as long as the grain. Staminate spikelets: Borne on slender erect pedicels; few, dorsally compressed, narrowly ovate, acuminate, 2.1-2.6 mm. long; glumes lacking; floret solitary; lemma 3-nerved; palea 2-nerved; lodicules 3, truncate, vasculated; anthers 3, 1.2-1.5 mm. long. Rachilla internodes of fruiting florets contain a liquid, oleaginous material. Chromosome number $2n = 22$ from a Costa Rican specimen.

Rare; mostly in dense undisturbed rain forests below 100 m. elevation. Hamburg Finca; Puerto Viejo; La Selva; Río Hondo; NE slope of Volcán Orosí, 400 m. elevation. Our specimens have blooming or fruiting dates from December, January, April, and August, and it is possible that the plants bloom yearlong. They are nowhere common,

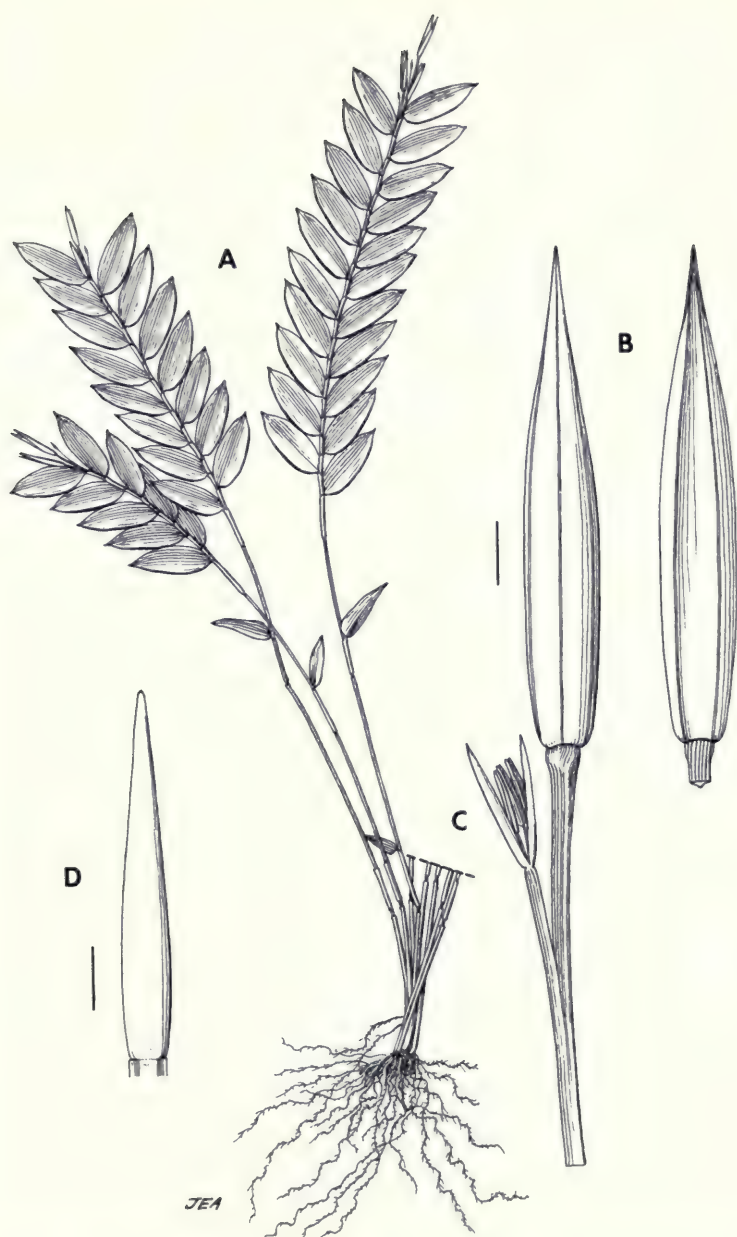


FIG. 48. *Cryptochloa concinna*. A, blooming plant; B, two views of pistillate spikelet; C, staminate spikelet; D, pistillate floret on rachilla internode.

and usually occur in small numbers on slopes. The Río Hondo collection was made in an old cacao grove. Nicaragua to Panama and Colombia.

Cryptochloa granulifera Swallen, Ann. Missouri Bot. Gard. 29:321. 1942. Figure 49.

Plants perennial, densely caespitose, 33-55 cm. tall, forming vase-shaped clumps of numerous ascending and arching culms; lower internodes elongated, the lower 1-3 nodes bearing bladeless sheaths or short sheaths with reduced blades; culm internodes roughened or retrorsely hispidulous, purple, thick-walled with a small lumen; nodes conspicuously enlarged, with a constricted ring at the middle of the enlarged portion, retrorsely hispidulous; sheaths tight, slightly keeled near the apex, puberulent or granular roughened, minutely ciliate; collar hispidulous; apex of the sheaths with erect auricles, the stiff membranaceous ligule 4-6 mm. long, adnate to the sheath margins, rounded or acute at the apex, puberulent on the back; pseudopetiole thick and fleshy, ca. 1.5 mm. long, puberulent, serving as a pulvinus to orient the blades in one plane parallel to the length of the stem during the day and to fold them face to face at night; blades flat, deep green above, purplish beneath, 5-8 cm. long, 14-24 mm. wide, ovate, 3-4:1, abruptly acute at the tip; usually 5-17 blades crowded near the apex of the culms, the sheaths overlapping; margins of adjacent blades approaching or overlapping. Inflorescences several, axillary from the upper leaf sheaths or terminal, the peduncles not exerted; some inflorescences bearing only pistillate spikelets, others with 1-several terminal pistillate spikelets, the lower branches bearing racemously arranged staminate spikelets, the rachis and pedicels angular or flattened, scabrous on the angles. Pistillate spikelets: Erect at the thickened tip of the pedicel, dorsally compressed, ovate 7:1; glumes subequal or the first slightly longer, 10.5-12 mm. long, acuminate, often tapering into an awn up to 1.5 mm. long; first glume with 3 conspicuous nerves and 2 very faint marginal ones; second glume 5-nerved, the lateral pairs of nerves close to the margins; glumes deciduous after the fall of the floret; floret 1, supported on a thick, rigid rachilla 1.2-1.5 mm. long and deciduous along with the rachilla; floret dorsally flattened, ovate 4:1, tapered to a blunt tip, rigid, shining, ivory white; lemma ovate 2:1 when flat, the margins incurved over the edges of the palea, flat; nerves 5, faintly visible internally; palea similar to the lemma, very broadly ovate 2:1, the margins strongly incurved; lodicules 3, flat, truncate, vasculated; style 1; stigmas 2, exerted apically; caryopsis elliptic ovate 3:1, ca. 5 mm. long, blunt on both ends, dorsally flattened, the pericarp orange; embryo small, basal, a dark line running the full length of the side opposite the embryo. Staminate spikelets: Borne on 1-several lower branches or lower portions of branches of the inflorescence, appressed, on pedicels 1-3.5 mm. long; glumes absent; floret 1, dorsally compressed, triangular 10:1; lemma herbaceous, 4.8-6.0 mm. long, acuminate, 3-nerved, the lateral nerves near the margin; palea equal to the lemma, with 2 keel nerves and 2 faint marginal nerves; lodicules 3, fleshy, truncate, vasculated; anthers 3, yellow, 2.4-2.6 mm. long, filaments short, fleshy, erect.

This species is known from Costa Rica only from the following specimens. The plants were abundant in moist forest remnants on steep slopes. Live plants from Río Tenorio are now growing vigorously in the Iowa State University greenhouse and have bloomed. Guanacaste, Crossing of Río Tenorio, ca. 3 km. S of Río Naranjo, elevation ca. 400 m., *Pohl & Lucas 13061*, 18 December 1974; Alajuela, 9 km. by road N of Bijagua, elevation 240 m., 17 June 1976, *Pohl &*



FIG. 49. *Cryptochloa granulifera*. A, plant; B, inflorescence with pistillate spikelets above, staminate spikelets at lower left; C, two views of a pistillate floret on a thickened rachilla internode.

Pinette 13233. Mexico, Guatemala, and Honduras, northwestern Costa Rica, Panama.

CYMBOPOGON Sprengel

Caespitose perennial grasses; foliage aromatic (lemon-scented in ours); inflorescence a dense terminal compound panicle, the branches of the various orders subtended by bladeless sheaths; ultimate inflorescence unit a pair of rames, exerted laterally from a bladeless sheath; one rame sessile at the apex of the peduncle, the other short-stalked, the two equal; rames short, composed of several pairs of spikelets borne on a flattened, readily disarticulating rachis; one spikelet of each pair sessile, the other pedicellate, both falling together or the pedicellate one disarticulating; basal pair of spikelets in some rames equal, awnless, and staminate; other pairs consisting of a sessile, perfect-flowered, awned spikelet and a pedicellate staminate or sterile spikelet, both usually similar and of about equal size. Sessile spikelets: Glumes equal, ovate, coriaceous, covering and concealing the florets; first glume flat, laterally keeled, usually nerveless between the ciliate keels; upper margins sharply inflexed, covering the edges of the second glume; second glume boat-shaped, keeled near the apex, 1-3-nerved; lower lemma membranaceous, nerveless, ciliate, lacking both flower and palea; upper lemma narrowly triangular, membranaceous, minutely toothed at the apex, tapering toward a short, straight awn (scarcely exerted in our species); palea minute or lacking; lodicules 2, truncate; stamens 3; styles 2, naked at the base; stigmas exerted laterally. Pedicellate spikelets: Similar to the sessile ones, but the first glume somewhat rounded on the back, 5-9-nerved, of softer texture than that of the sessile spikelet; second glume 1-3-nerved, boat-shaped; lemma solitary, membranaceous, sterile or with 3 stamens but no pistil.

Cymbopogon contains about 30 species of grasses of the tropics of the eastern hemisphere. Several are cultivated for their aromatic constituents. In the structure of the inflorescence, the species are close to *Andropogon* and *Hyparrhenia*. (Panicoideae: Andropogoneae.) *Cymbopogon citratus*, known as *Zacate de limón* or *Sontol*, occurs commonly at low elevations in Central America, but practically never blooms. It can readily be recognized by its lemon odor.

***Cymbopogon citratus* (DC) Stapf, Kew Bull. 1906:357. *Andropogon citratus* DC, Cat. Hort. Monspel. 78. 1813. Figure 50.**

Perennial, forming dense vegetative clumps; individual stems very short (5-10 cm.), ca. 1 cm. thick, solid, stiff and woody, with very short internodes, 3-6 mm. long; foliage in vegetative forms all basal, leaf sheaths closely overlapping, gaping with age and forming somewhat flattened fans, surfaces glabrous, heavily glaucous outside and inside with loose, powdery wax deposits; sheath auricles erect, rounded, longer than the ligule and adnate to its margins; ligule a stiff, erect membrane, 2.0-2.5 mm. long, minutely ciliate, straight; leaf blades at first ascending, finally drooping, up to 70 cm. long and 18 mm. wide, glabrous, light green, broadest at the middle, tapering to a narrow base; margins thick, white, scabrous; midrib broad, white, protruding on the abaxial surface. Culms usually absent, the plants essentially nonblooming. Culms up to 2 m. tall, un-



FIG. 50. *Cymbopogon citratus*. A, plant base with overlapping sheaths; B, compound inflorescence of numerous bracted rames.

branched; inflorescence a large terminal panicle of rames, up to 60 cm. long and ca. one-third as wide, open to rather dense, complexly branched, the branches of each order subtended by bladeless sheaths. Ultimate inflorescence unit a pair of short, usually reflexed rames, exserted near the base of a bladeless sheath on a short peduncle; rames 1.0-1.5 cm. long, one of each pair sessile, the other on a very short peduncle; spikelets paired, one sessile and the other pedicellate, the rame consisting of 1-4 pairs of spikelets and a terminal triad of one sessile and 2 pedicellate ones; disarticulation at the base of each rachis internode and pedicel; internodes and pedicels flattened, strongly ciliate on the margins. Sessile spikelets: 3.2-5.0 mm. long, ovate 3:1, acute; first glume flat on the back, the margins sharply inflexed and keeled, ciliate above; area between the keels nerveless or with 2 weak nerves near the bifid tip; second glume boat-shaped, slightly shorter than the first and clasped by its margins, 1-3-nerved; lower lemma membranaceous, ovate, ciliate-margined, 2.8-3.2 mm. long, lacking a flower or palea; upper (fertile) lemma subulate, 2.0-2.5 mm. long, membranaceous, tapering into a weak awn 1-2 mm. long, usually straight or slightly twisted near the base; palea minute or lacking; lodicules 2, truncate; stamens 3, the anthers yellow, 1.0-1.5 mm. long; style branches 2, naked near the base; stigmas purple. Pedicellate spikelets: Similar to the sessile ones but usually somewhat smaller, awnless; first glume slightly rounded on the back, 2.5-4.4 mm. long, 5-9-nerved; second glume 1-nerved or faintly 3-nerved; spikelets empty or with the lower lemma developed, sometimes with a staminate flower, the 2-3 anthers yellow, 2-3 mm. long; no palea, upper lemma, or pistil observed.

This species occurs around houses, but is apparently not cultivated on a commercial scale in Costa Rica. It is said that the strongly scented foliage is used for teas. The odor closely mimics that of lemon. Native to India and widespread in the tropics. Because of the lack of flowering, the plants can be spread only by cultivation. In Guatemala, "lemon grass" is cultivated on a large scale on the Pacific Coastal Plain for the production of lemon oil. A few flowering specimens are known from cultivation. This species bloomed in El Salvador in June 1932. A blooming specimen from El Zamarano, Honduras, was collected in November 1948, and another from Turrialba, Costa Rica, in October 1950. We have never observed flowering. Common names: *Zacate de limón*, *Sontol*.

CYNODON L. C. Richard

REFERENCES: W. D. Clayton & J. R. Harlan, The genus *Cynodon* L. C. Rich. in tropical Africa, Kew Bull. 24:185-189. 1970. J. R. Harlan, J. M. J. de Wet, W. W. Huffine, & J. R. Deakin, A guide to the species of *Cynodon* (Gramineae), Oklahoma Agric. Exp. Sta. Bull. B-673:1-37. 1970. J. M. J. de Wet & J. R. Harlan, Biosystematics of *Cynodon* L. C. Rich. (Gramineae), Taxon 19:565-569. 1970.

Stoloniferous or rhizomatous perennials; inflorescence of 1-several whorls of slender spikes; spikelets sessile or nearly so in 2 rows along the lower side of the slender rachis. Spikelets 1-flowered, laterally compressed and keeled; glumes narrow, 1-nerved, often

arcuate, usually shorter than the floret; lemma boat-shaped, 3-nerved, the lateral nerves marginal; palea nearly as long as the lemma; rachilla extended behind the palea as a naked bristle.

This is a small (ca. eight species) but important genus of the warmer regions of the Old World. Some of the species are extensively variable. Various species and minor variants, including hybrids, are used as lawn and pasture grasses. Leaves on stolons are subopposite, because of alternating long and short internodes of the stems. *Cynodon dactylon*, "Bermuda grass," is one of the most common pantropical weeds. (Chloridoideae: Chlorideae.)

KEY TO SPECIES OF *Cynodon*

- 1a. Plants producing rhizomes as well as stolons; plants usually not more than 20 cm. tall; mostly wild plants *C. dactylon*
- 1b. Plants producing stolons only; plants up to 60 cm. tall; stolons thick and coarse; cultivated crop plant *C. nlemfuensis*

***Cynodon dactylon* (L.) Pers., Syn. Pl. 85. 1805. *Panicum dactylon* L., Sp. Pl. 58. 1753. Figure 51.**

Perennial, spreading extensively by stolons and rhizomes; culms erect, usually less than 20 cm. tall; stolons with alternating long and short internodes, causing the leaves to appear subopposite; culms numerous, arising from the nodes of the stolons, unbranched, ca. 1 mm. thick, hollow but thick-walled, glabrous; nodes glabrous; prophylla short, broadly winged, 3-4 mm. long; foliage grayish-green; sheaths mostly glabrous, bearing long soft hairs on the auricles and collar; leaf blades 1-12 cm. long, 2-4 mm. wide, flat or folded, the tip blunt, mostly glabrous, but with long soft hairs on the basal margins of the blade and on the upper surface behind the ligule; ligule membranaceous, ciliate, 0.2-0.3 mm. long. Peduncle slender, glabrous, exserted; inflorescence solitary, terminal, a single whorl of usually 4-6 slender spikes, usually 1.5-3 cm. long, rarely longer. Spikelets overlapping, appressed to the rachis; 2.0-2.5 mm. long; glumes subequal, 1.1-1.7 mm. long, the first linear, arcuate, appressed to the keel of the lemma, the second straight, subulate, usually diverging from the floret; lemma boat-shaped, usually slightly silky on the keel, rarely glabrous; palea about as long as the lemma; rachilla prolonged behind the palea, about half as long as the floret, bearing a rudiment up to half its own length (rarely missing); anthers 3, yellow, 1.0-1.4 mm. long. Chromosome number usually $n = 18$, sometimes 9.

Common, mostly as a weed or in pastures, from sea level to 1,500 m. elevation. Blooming yearlong. This is one of the commonest introduced grasses. It is variously known as "Bermuda grass," "grama," or *zacate* *Bermuda*. Throughout warm climates of the world, apparently originating in Africa. A number of varieties are listed by de Wet and Harlan from the Old World.

***Cynodon nlemfuensis* Vanderyst, Bull. Agric. Congo Belge 13:342.**



FIG. 51. *Cynodon* species. *C. dactylon*: A, blooming plant; B, spikelet and floret with rachilla internode; *C. nlemfuensis*: C, blooming plant; D, spikelet and floret with rachilla internode.

1922. *C. dactylon* (L.) Pers., var. *sarmentosus* Parodi, Revista Argent. Agron. 23:185. 1956. Figure 51.

Coarse stoloniferous perennial, lacking rhizomes; culms erect from the nodes of the stolons, unbranched, hollow, 2 mm. thick, glabrous, 30-60 cm. tall; stolons 2-3 mm. thick, with alternating long and short internodes, the leaves appearing to be subopposite; branching extensive; prophylla prominent, 7-25 mm. long; sheaths glabrous; ligule a minutely ciliolate membrane, 0.3 mm. long; blades flat, 5-16 cm. long, 2-6 mm. wide, bearing long soft hairs on the auricles, dewlap, and base of the blade, especially behind the ligule; sometimes with scattered hairs on the surface, especially beneath; inflorescence solitary, terminal, of 1-2 whorls of slender spikes, usually 4-9 spikes per inflorescence; racemes 4-10 cm. long; spikelets 2-3 mm. long; glumes subequal, 1.8-2.3 mm. long, the first arcuate, linear, appressed to the keel of the lemma; second glume narrowly lanceolate, diverging from the floret; lemma 2.5-2.8 mm. long, boat-shaped, softly appressed-pubescent on the keel; palea equal to the lemma; rachilla ca. half the length of the palea, the rudiment minute; anthers 3, yellow, 1.2 mm. long. Chromosome number $n = 9$.

This African species has been cultivated in the grass garden of the IICA at Turrialba, and is now being cultivated extensively in the Orosi area and in Guanacaste, as well as in other parts of Central America. The plants are much larger and more vigorous than the common weedy type of *C. dactylon*. It may possibly be cultivated under the name of *Estrella africana* or "African stargrass" or as *C. plectostachyus*.

CYNOSURUS Linnaeus

Inflorescence a dense terminal panicle; spikelets paired, of 2 kinds, one of each pair sterile and one fertile; sterile spikelets conspicuous, fan-shaped, with 2 glumes and a number of empty sterile lemmas borne on nondisarticulating rachilla; fertile spikelets similar, mostly hidden by the sterile ones, 2-5-flowered; glumes slender, 1-nerved; spikelets disarticulating above the glumes and between the florets; lemmas with a visible midrib and very inconspicuous lateral nerves, short-awned. (Pooideae: Poeae.)

Cynosurus cristatus L., Sp. Pl. 72. 1753. Figure 52.

Caespitose perennial, leafy at the base; plants 20-80 cm. tall, culms unbranched, with 2-3 nodes, 1.0-1.5 mm. thick, hollow; sheaths much shorter than the slender glabrous internodes; ligules 1-1.5 mm. long, membranaceous, auriculate, decurrent on the sheath; blades mostly basal, 4-15 cm. long, 1.5-2.5 mm. wide, glabrous; panicles solitary, terminal, densely cylindrical, 2-8 cm. long, ca. 1 cm. wide, the branches very short and few-flowered; sterile spikelets fan-shaped, lustrous, mostly borne exterior to the fertile ones, slightly larger than the fertile spikelets; lemmas empty, 1-nerved, 3-5 mm. long; fertile spikelets 3-6 mm. long; glumes 3-5 mm. long, 1-nerved, narrowly lanceolate; lemmas 3-4 mm. long, narrowly ovate, tapering abruptly to a short awn-point, scabrous on the upper half; paleas 2-keeled, glabrous; anthers 3, yellow, ca. 2 mm. long. Chromosome number $n = 7$.

This species is known from Central America only from the following specimen: Cartago, pastures on south slope of Volcán Turrialba, eleva-



FIG. 52. *Cynosurus cristatus*. A, sterile spikelet; B, fertile spikelet; C, inflorescence.

tion 2780 m., *Pohl & Davidse 10865*, 8 August 1968. *Cynosurus cristatus* is a European species, rather sparingly introduced in northeastern North America and the Pacific Coast states of the United States. Like *Danthonia decumbens*, *Festuca rubra*, *Poa annua*, *P. trivialis*, and a number of other species, it probably represents an early introduction to Costa Rica in pasture seed. Only a few plants were seen, and the plants have no economic utility in Costa Rica.

DACTYLIS Linnaeus

Tufted perennial, forming large clumps; culms erect; herbage generally glabrous, pale green; sheaths keeled, with united margins; ligules prominent, membranaceous, lacerate; leaf blades flat or folded; panicles simple, with few straight, stiff branches which are naked for most of their length and bear dense tufts of nearly sessile spikelets at their outer ends; spikelets strongly flattened, the glumes and lemmas strongly keeled, usually pectinate-ciliate on the keels; lemmas 5-nerved, tapering into a short awn-tip; disarticulation above the glumes and between the florets. (Pooideae: Poaeae.)

Dactylis glomerata L., Sp. Pl. 171. 1753. Figure 53.

Plants forming large tufts; culms up to 140 cm. tall, erect; blades 10-45 cm. long, 2-14 mm. wide; ligules 2-12 mm. long. Panicles up to 30 cm. long, the few stiff branches spreading in anthesis but erect later. Spikelets 5-9 mm. long, 2-5-flowered; glumes lanceolate, 1-3-nerved, 4-6.5 mm. long; lemmas closely imbricated, strongly keeled, 5-nerved, 4-7 mm. long; palea about equal to the lemma; keels of lemmas usually prominently short pectinate-ciliate. Chromosome number $n = 14$ from a Costa Rican specimen.

Middle and higher elevations; Irazú and Turrialba. Introduced from Europe as a pasture and hay grass and naturalized on the volcanoes. Widespread in temperate humid areas of the world, where it is cultivated as a forage crop. This species is said to be used as a hay crop in Costa Rica, but it does not appear to be abundant at the present time. Common name: "orchard grass."

DACTYLOCTENIUM Willdenow

REFERENCE: B. E. Fisher & H. G. Schweickerdt, A critical account of the species of *Dactyloctenium* Willd. in Southern Africa, Ann. Natal Museum X:47-77. 1941.

Annual or perennial caespitose or stoloniferous grasses. Inflorescence a whorl of several spreading or reflexed one-sided spikes, the axis prolonged as a naked point beyond the spikelets. Spikelets sessile, densely imbricated in 2 rows along the lower side of the rachis, laterally compressed and keeled; glumes 2, keeled, 1-nerved, broad, the second truncate, with a short, divergent awn; disarticulation between the glumes, the second falling with the several florets; lemmas ovate, pointed or apiculate, strongly compressed and keeled, 3-nerved, the midnerve prominent, green, the lateral nerves obscure, sub-

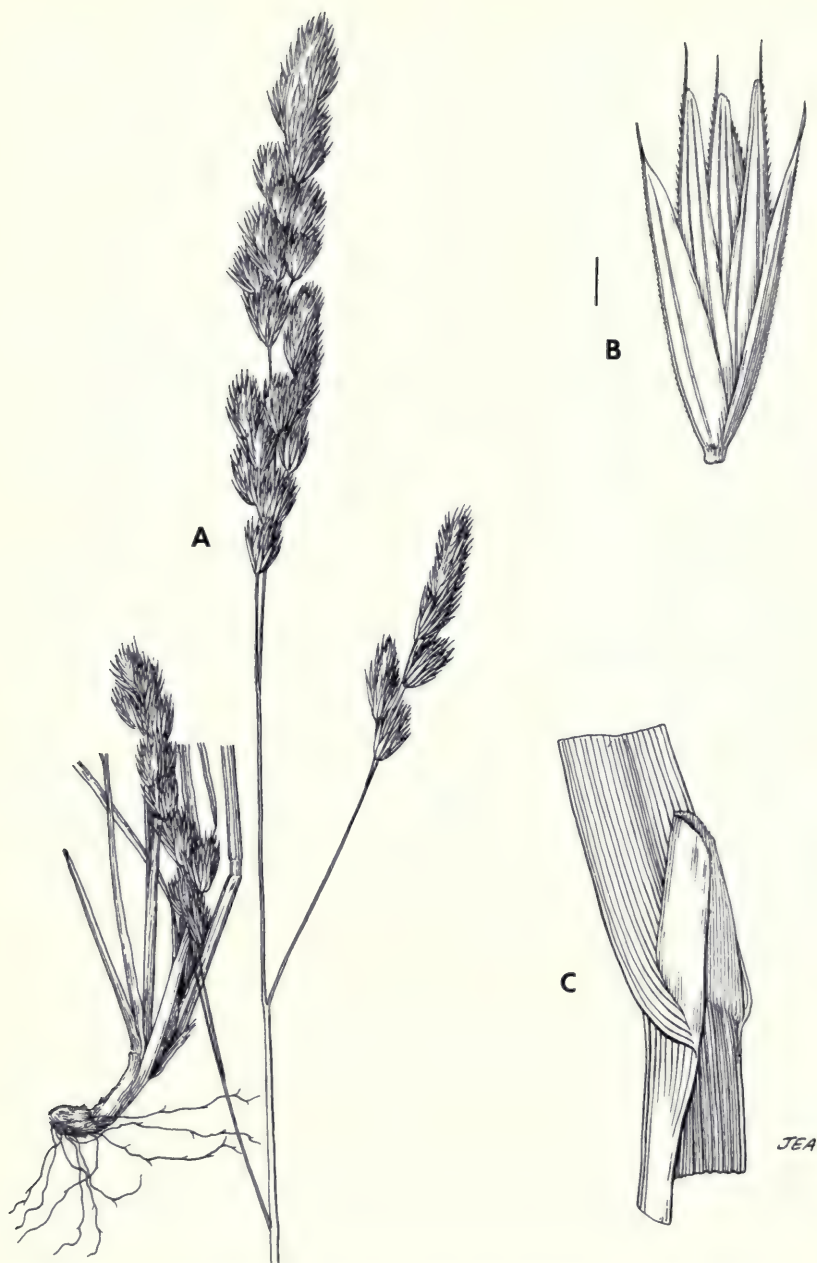


FIG. 53. *Dactylis glomerata*. A, inflorescence and culm base; B, spikelet; C, base of blade with ligule.

marginal; second glume and lemmas disarticulating from the intact rachilla, the paleas remaining attached; palea about as long as the lemma; lodicules 2, truncate, anthers 3, seed broadly ovate, truncate, with strong transverse ridges; pericarp thin and delicate, disappearing before maturity.

This is a small genus of ca. 10 species of warm climate grasses, native to Eurasia, Africa, and Australia; introduced in warm climates in the Americas. *Dactyloctenium* is closely related to *Eleusine*, and the plants are similar in habit and inflorescence structure. (Chloridoideae: Eragrostaceae.)

***Dactyloctenium aegyptium* (L.) Beauv., Ess. Nouv. Agrost. 72; Pl. XV, Fig. 2. 1812. *Cynosurus aegyptius* L., Sp. Pl. 72. 1753. Figure 54.**

Plants annual in temperate climates, of indefinite duration in the tropics; spreading by short stolons and forming radiate mats, the erect portions of the culms 2-50 cm. tall; branching abundant on the creeping stolons, the erect culms unbranched, 1.0-1.5 mm. thick, glabrous, solid, the nodes with conspicuous pulvini; prophylla prominent, 10-15 mm. long, with 2 ciliate awns up to 3 mm. long; leaf sheaths carinate, overlapping on short shoots, shorter than the internodes on the culms, glabrous to pustulose-villous; ligule a thin brownish ciliate membrane, ca. 0.5 mm. long; leaf blades 1-7 cm. long, 1-7 mm. wide, the uppermost much reduced; midrib prominent; blades papillose-villous on the margins and more or less on both surfaces, occasionally glaucous. Peduncle glabrous, exserted 1-10 (-20) cm. long; inflorescence a whorl of usually 2-4 unilateral spikes, terminal on the culm, rarely a solitary spike in depauperate plants; spikes subsessile, 1-3 cm. long, the axis extended beyond the spikelets as a short naked point; spikelets densely crowded in 2 overlapping rows on the lower side of the rachis. Spikelets gray to purplish, strongly laterally compressed and keeled, ca. 4 mm. long; first glume 1-nerved, 2 mm. long, ovate, apiculate; second glume similar but longer, ca. 3 mm. long, broadly ovate, with a short thick divergent awn; disarticulation usually above the first glume but not between the florets; florets usually 3, the uppermost often sterile; lemmas 2-3 mm. long, ovate, the keel strongly bowed; midnerve conspicuous, green, the lateral nerves very inconspicuous; keel scabrid; tip acuminate; palea ca. 2 mm. long, ciliate on the keels; anthers 3, ca. 0.4 mm. long, yellow; pericarp very thin and fragile, soon shed, the rugose, angular brown seed then free. Chromosome numbers $2n = 46, 48, 45, 20, 36, 40$ (Gould & Soderstrom, 1974).

Savannas, pastures, beaches, weedy open areas, from sea level to 1,200 m. elevation, on both Caribbean and Pacific slopes. Blooming yearlong. Introduced from the Old World. Southern and eastern United States through the tropics to Uruguay.

Where plants of this species grow on bare soil, they make decumbent circular mats, with considerable stoloniferous spread. Extreme dwarfing of the plants can occur under drought or poor soil conditions, and such plants may often show glaucous leaves. Seeds from such glaucous plants, grown in the greenhouse on sand or loam soil with adequate moisture produced only green-leaved plants.



FIG. 54. *Dactyloctenium aegyptium*. A, plant with stoloniferous base and inflorescence; B, spikelet.

DANTHONIA Lamarck & De Candolle
Nomen Conservandum

Caespitose perennial grasses; inflorescence a solitary terminal panicle; spikelets several-flowered; glumes as long as the spikelet, equal, many-nerved; disarticulation above the glumes and between the florets; lemmas 5-7-nerved, awned between 2 apical teeth, or the apex of the lemma trifid; flowering mostly cleistogamous; axillary cleistogenes also produced inside the sheaths at the lower nodes; culms disarticulating at the lower nodes and discharging the cleistogenes at maturity. (Arundinoideae: Danthonieae.)

Danthonia decumbens (L.) Lam. & DC., F. Franc. ed. 3, Vol. 3:33. 1805. *Festuca decumbens* L., Sp. Pl. 75. 1753. *Sieglingia decumbens* (L.) Bernh., Syst. Verz. Erf. 20:44. 1800. Figure 55.

Caespitose perennial, forming dense clumps; culms 20-50 cm. tall, erect to ascending, ca. 1 mm. thick, hollow, glabrous; leaf blades mostly at the base of the culms; sheaths more or less hairy on the upper half; innovations extravaginal; prominent auricular hairs present; ligule a dense circle of hairs, ca. 0.5 mm. long; blades 4-10 cm. long, 1.5-3 mm. wide, ribbed on both surfaces, flat or inrolled, bearing scattered long weak hairs. Panicles 2-6 cm. long, contracted, few-flowered. Spikelets almost entirely cleistogamous; glumes equal, 6-12 mm. long, 5-7-nerved, broadly lanceolate, rounded on the back, overlapping; florets 4-7; lemmas 4-6 mm. long, oval to broadly ovate, 9-nerved, rounded on the back, bluntly 3-toothed at the tip, smooth and shining, firm, ciliate on the lower margins, otherwise glabrous; callus projecting, bearing tufts of hairs ca. 1 mm. long; palea 4-5 mm. long, broadly ovate, the keels prominent and conspicuously thickened below into pulvini; rachilla segments slender, smooth, 0.6-0.7 mm. long; anthers 3, those of cleistogamous flowers 0.2-0.3 mm. long, those of the rare chasmogamous flowers 1-2 mm. long; lodicules not developed; anthers remaining entangled with the stigmas and persisting on the tip of the fruit; caryopsis 2.0-2.5 mm. long, elliptic, flattened, with a terminal appendage. Basal sheaths swollen just above the nodes and containing cleistogenes; the cleistogene enveloped in a prominent prophyllum ca. 10 mm. long, short-pedicellate, with 1 or 2 abortive glumes ca. 1-4 mm. long; florets 1 or rarely 2, 5-8 mm. long, the rachilla sometimes prolonged and bearing a reduced abortive floret; culms eventually breaking at the nodes and releasing the cleistogenes. Chromosome number $n = 18$ from Costa Rican specimens; $n = 28, 36, 124$ also listed by Bolkhovskikh et al. (1969).

This is an introduced European species, probably imported at an early date in pasture seed mixtures. The only known localities from Central America are the following: Alajuela, Volcán Poás, 1 km. below crater on road; elevation 2,310 m., *Pohl & Davidse 10813*; Cartago, Volcán Turrialba, southern slope, open pastures above the lechería, elevation 3,000 m., *Pohl & Davidse 10858*. The above two specimens were blooming in August. Few plants were found. *Danthonia decumbens* is native in Europe and Asia Minor and Northwest Africa and has been introduced in northeastern United States and Canada and in New Zealand.



FIG. 55. *Danthonia decumbens*. A, spikelet; B, two views of a floret; C, inflorescence.

This peculiar cleistogamous grass has usually been assigned to the genus *Sieglingia*; however, Conert (1969) has shown that it is very similar in morphology and biology to the other species of *Danthonia*, differing only in the absence of a developed awn. It also forms spontaneous hybrids with *Danthonia alpina*, a European species. For this reason, he assigns it to *Danthonia*. The generic name *Sieglingia* Bernh. (1800) antedates *Danthonia* by five years. Because of the necessity of combining the two genera, *Danthonia*, which has many species, was conserved over *Sieglingia* with only one.

DESCHAMPSIA Beauvois

Caespitose, usually perennial grasses; inflorescence a terminal panicle. Spikelets 2-flowered; glumes subequal, keeled, longer or shorter than the florets; disarticulation above the glumes and between the florets; lemmas lobed at the apex; awn inserted below the middle of the back of the lemma; rachilla internodes short, the rachilla extended above the base of the second floret as a short bristle.

This genus is allied to *Trisetum*, from which it differs in the basally attached awns, and to *Aira*, which lacks the prolonged rachilla. *Deschampsia* has about 35 species in cool and alpine regions of the world. (Pooideae: Aveneae.)

KEY TO SPECIES OF *Deschampsia*

- 1a. Panicle open, pyramidal, the few-flowered branches naked for their lower halves
D. flexuosa
- 1b. Panicle densely cylindrical with closely overlapping spikelets *D. pringlei*

***Deschampsia flexuosa* (L.) Trin., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4:9. 1838. *Aira flexuosa* L., Sp. Pl. 65. 1753.**

Caespitose perennial, in dense tufts; plants 30-85 cm. tall; foliage mostly basal, the leaf blades capillary, mostly 10-15 cm. long, less than 1 mm. wide, involute, glabrous; ligule a firm membrane, 0.5-1.5 mm. long; culms slender, the internodes very elongate. Peduncle elongate, exerted up to 30 cm.; inflorescence a solitary very open terminal panicle, pyramidal, the few branches naked for the lower one-half to two-thirds, bearing few spikelets, these borne on slender pedicels longer than the spikelets themselves. Spikelets usually purplish, 4.0-5.8 mm. long, laterally compressed; glumes shorter than the spikelet, rounded on the keel, 1-nerved, ovate, acuminate, the first 3.0-4.4 mm. long, the second 3.6-5.0 mm. long; florets close to each other, the rachilla internode very short, 0.3-0.8 mm. long, bearded; lemmas scaberulous, lanceolate, faintly 5-nerved, bidentate at the acuminate tip; callus short-bearded; awn 5-7 mm. long, inserted just above the base of the lemma, the lower segment tightly twisted, brown, the terminal segment exerted from the glumes; palea about as long as the lemma, scabrous on the keels; anthers 3, purplish, 2.1-3.0 mm. long; caryopsis linear, rigid.

Collected only once in Costa Rica, from a pasture on the south slope

of Volcán Turrialba at 3,000 m. elevation. August. This is a species of temperate and arctic North America and Eurasia. It has not previously been reported from Central America. Its presence in a high elevation pasture along with other species of northern European origin suggests that it was introduced in pasture seed mixtures of European origin.

Deschampsia pringlei Scribner, Proc. Acad. Nat. Sci. Philadelphia 43:300. 1891. Figure 56.

Caespitose perennial; plants 30-100 cm. tall, erect; culms unbranched, 1-2 mm. thick, hollow, thin-walled, glabrous and shining; nodes conspicuous, dark and shrunken; leaf sheaths shorter than the internodes, glabrous, striate; ligule a firm truncate membrane, 1.5-2.5 (-4) mm. long; blades flat, 7-12 cm. long, 2-4 mm. wide, minutely scaberulous. Peduncle glabrous, exserted up to 20 cm.; panicle solitary, terminal, densely cylindrical, somewhat lobed below, 10-15 cm. long, 5-15 mm. thick, grayish or pinkish; spikelets densely overlapping on the short erect branches, the short pedicels hispidulous. Spikelets 4.8-5.6 mm. long, laterally compressed, the glumes subequal, keeled, 1-nerved, longer than the florets, the keels scabrous; first glume 4.0-4.9 mm. long, ovate, acuminate, the second similar, 4.2-5.6 mm. long; disarticulation above the glumes and between the 2 florets; lemmas 3.3-4.3 mm. long, lanceolate, faintly 5-nerved; callus short-bearded; apex lobed 1.0-1.5 mm., the lobes rounded or erose; awn geniculate, exserted, 4.5-5.0 mm. long, inserted ca. one-fourth above the base of the lemma; palea 3.0-3.6 mm. long; rachilla internodes very short, bearded; anthers 1.2-1.3 mm. long, whitish; caryopsis linear-cylindrical, soft, the endosperm pasty. Chromosome number $n = 14$ from a Costa Rican specimen.

Rare, margins of a quebrada below San Juan de Chicao at 2,600 m. elevation. Previously known from southern Mexico and Guatemala.

Deschampsia pringlei has recently been transferred to the genus *Peyritschia* by Stephen D. Koch in Taxon 28: 233, 1979. The genus *Peyritschia* differs from *Deschampsia* in having a soft caryopsis with liquid interior and basal shoots bursting through the base of the subtending sheath. The genus *Peyritschia* differs from *Trisetum* in having a bilobed apex on the lemma, glumes exceeding the florets and stamens 2 per floret.

DIECTOMIS Kunth Nomen Conservandum

Caespitose; inflorescences numerous, terminal and axillary, each one a solitary rame or a conjugate pair of rames on a bracted peduncle; rachis disarticulating readily into individual segments, each bearing a dimorphic pair of spikelets; rachis internodes and pedicels flattened, narrowly obtriangular, with silky-ciliate edges and an obliquely cup-like toothed apex; sessile spikelet remaining attached to the rachis internode and pedicel, perfect-flowered, strongly laterally compressed; first glume narrow, 2-keeled, grooved between the keels, second glume strongly laterally compressed and keeled,

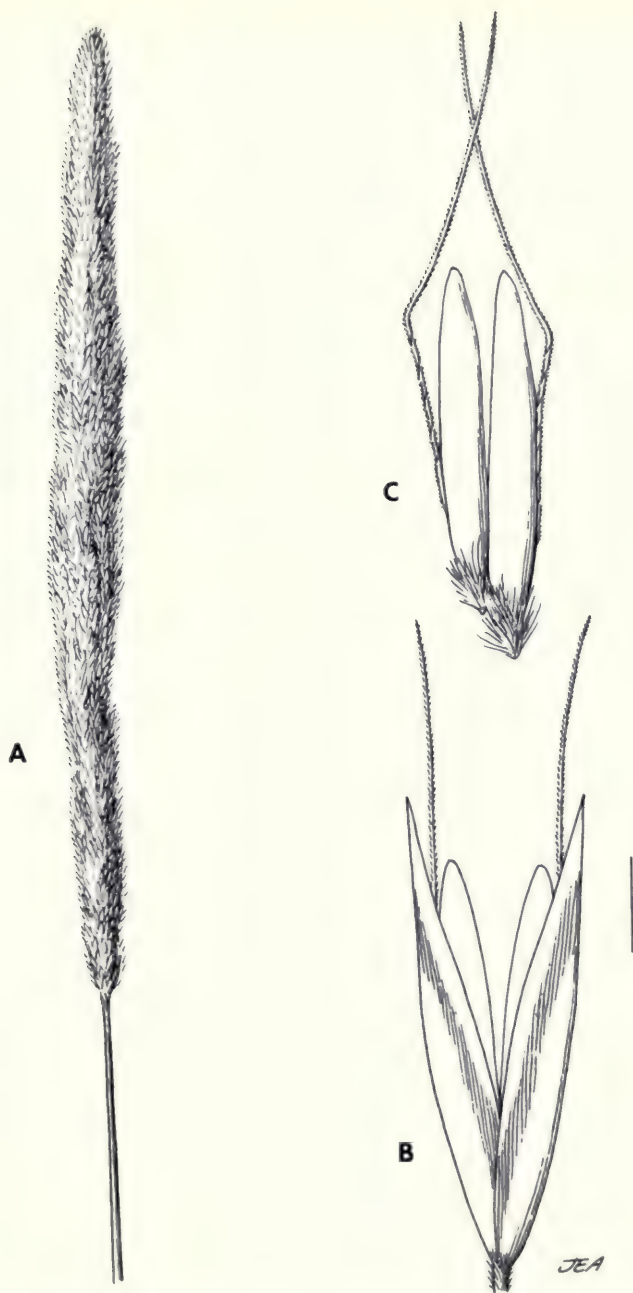


FIG. 56. *Deschampsia pringlei*. A, inflorescence; B, spikelet; C, florets.

boat-shaped, bearing a long curved awn from the tip; sterile lemma hyaline, 2-keeled, narrowly lanceolate; fertile lemma hyaline, strongly keeled, the keel curved to fit the second glume, bearing a long exerted twisted and geniculate brown awn from between 2 triangular teeth; palea hyaline; flower perfect; pedicellate spikelet larger than the sessile one, readily deciduous from the pedicel, sterile or staminate; first glume broad and flat, stiff, several-nerved, asymmetric, awned from the acute apex, the margins narrowly and sharply inflexed, the folded edge strongly scabrous or ciliate; second glume shorter and narrower than the first, oblong, membranaceous, bearing a short straight apical awn. Terminal segment of the rachis bearing one sessile and 2 pedicellate spikelets.

Diectomis is a small genus of tropical grasses of both eastern and western hemispheres, related to *Andropogon* and sometimes included as a section of that genus. It differs in the strongly laterally compressed sessile spikelets with awned second glumes, and in the enlarged pedicellate spikelets. The plants are probably annual. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Diectomis*

- 1a. Rames solitary on each peduncle *D. fastigiata*
- 1b. Rames paired at tip of each peduncle *D. angustata*

***Diectomis angustata* Presl, Rel. Haenk. 1:333. 1830. *Andropogon angustatus* (Presl) Steud., Syn. Pl. Glum. 1:370. 1854.**

Duration indefinite; plants caespitose, erect, 20-100 cm. tall; culms branching from the base and the middle and upper nodes, 1.0-1.5 mm. thick, hollow or pithy, glabrous; nodes glabrous, not prominent; sheaths shorter than the internodes, glabrous; ligule a truncate brown membrane, 1.0-2.5 mm. long, adnate to the upper sheath margins; leaf blades up to 30 cm. long, 1.5-3.0 mm. wide, glabrous, flat; midrib wide, white. Peduncles mostly enclosed in slender, bladeless sheaths; inflorescences terminal, of numerous individual peduncles arising from upper sheaths, each bearing a conjugate pair of rames, these 2-4 cm. long. Spikelets paired, one sessile and perfect-flowered, one pedicellate and sterile or staminate, both falling together with the rachis internode and pedicel when the rachis disarticulates; terminal sessile spikelet of each rame accompanied by 2 pedicellate ones; callus of sessile spikelet sharp, bearded, prolonged about 1 mm. below the insertion of the pedicel and rachis internode; pedicels and rachis internodes similar, ca. half as long as the sessile spikelet, very narrow at the base, wedge-shaped upward, slightly convex on the outer side, thin-walled and hollow, lower two-thirds of the edges ciliate, apex terminating in a very obliquely U-shaped cuplike apex, wider than the spikelet base above. Sessile spikelet: 4.4-5.0 mm. long; first glume deeply grooved on the back, ca. 6-nerved, lacking a midrib, bifid at the tip; second glume longer than the first, strongly keeled, boat-shaped, the spikelets appearing laterally compressed; glume faintly 3-nerved, bearing a slender awn, 10-15 mm. long from the blunt tip; lower lemma 1-nerved, thin, marginally ciliate, 2-keeled, lacking a midrib, 3.0-4.2 mm. long; upper lemma fertile, 2.8-4.0 mm. long, hyaline, 1-nerved, the awn arising from the bifid tip; awn twisted and geniculate, brown, slightly hispid, 3-5 cm. long; palea nerveless, 1.5-2.0 mm. long; lodicules 2, truncate; anthers 3, 1.7-2.1 mm. long. Pedicellate spikelets: Ovate 6:1, acute, 5.5-6.0 mm. long, dorsally compressed; first glume slightly convex, 3-7-

nerved, its margins inrolled over the edges of the second glume, ciliate above the middle; apex bifid, a straight awn 5-13 mm. long arising between the teeth; second glume rounded on the keel, 3-nerved, with an awn ca. 3 mm. long; florets absent or, in some cases, the spikelet with a lower lemma ca. 5 mm. long, thin and nerveless; upper lemma 5.1-5.3 mm. long, thin and ciliate, 1-nerved; palea 2.2-3.0 mm. long; lodicules 2, truncate; anthers 3, 2.5-3.0 mm. long. Chromosome number $n = 20$ from Costa Rican specimens.

Curatella-Byrsonima savannas, Guanacaste; elevation 100-250 m. October to December. Southern Mexico to Panama and Colombia, Venezuela, and northern Brazil.

Diectomis fastigiata (Swartz) Beauv., Ess. Nouv. Agrost. 132, 160. 1812. *Cymbachne fastigiata* (Swartz) Roberty, Mon. Androp. Boissiera 9:255, 1960. *Andropogon fastigiatus* Swartz, Prodr. Veg. Ind. Occ. 26. 1788. Figure 57.

Caespitose annual; plants 30-200 cm. tall, erect; branching abundant from middle and upper nodes; prophylla thin, brown, up to 5 cm. long; culms slender, hollow, smooth and glabrous; nodes glabrous, impressed; lower leaf blades very elongate, up to 35 cm. long, 1-3 mm. wide, tapering into an elongated awn tip, scabrous below, puberulent above, sometimes with scattered elongate weak hairs; upper leaves reduced to sheaths with awnlike reduced blades; ligule stiff, erect, brown, 2-11 mm. long, decurrent on the sheath margins; rames numerous, solitary or in small groups, exserted on slender branches from the middle and upper leaf sheaths; peduncle bearing at its base a spathe-like sheath which includes the base of the rame, its blade reduced to an awn; an elongated slender prophyllum borne within the spathe; rames 3-5 cm. long, of numerous pairs of spikelets, linear, flattened, the first glumes of the pedicellate spikelets conspicuous, imbricated; sessile spikelets 4-5 mm. long, deciduous with the rachis internode and pedicel; first glume linear, 2-keeled, silky between the keels, slightly longer than the second glume, 4.5-5.0 mm. long, awnless; second glume 4.0-5.0 mm. long, strongly compressed and keeled, the keel bowed out; sterile lemma ca. 3.5 mm. long, narrowly lanceolate, 2-keeled, conforming to the shape of the first glume, hyaline, the margin ciliate, lacking flower or palea; fertile floret ca. 3.0 mm. long, the keel of the lemma curved, conforming to the shape of the second glume, membranaceous, bifid at the apex and bearing a long awn, 3-4 cm. long; flower perfect; anthers 3, 1.5-1.8 mm. long, pinkish; palea 2.3-3.0 mm. long, hyaline. Pedicellate spikelet readily deciduous from the apex of the pedicel, its first glume oblong or obovate, stiff and flat, acuminate, somewhat asymmetric, bearing an awn ca. 10 mm. long, scabrous ciliate on the margins; second glume 3.5-5.0 mm. long, with a straight awn 2-10 mm. long; no flower present. Chromosome number $n = 10$ from Costa Rican material.

Scattered in northern Guanacaste; savannas, tuff outcrops, sea cliffs; Western Meseta Central; Boruca area and valley of Río Grande de Terraba; elevations from sea level to 800 m. Late October to March. Mexico to Brazil; West Indies; Tropics of the Old World.

DIGITARIA Haller

REFERENCES: J. Th. Henrard, Monograph of the genus *Digitaria*, Univ. Pers. Leiden. 999 pp. 1950. J. F. Veldkamp, A revision of *Di-*



FIG. 57. *Diectomis fastigiata*. A, rame; B, two views of a spikelet pair, showing enlarged sterile pedicellate spikelets.

gitaria Haller (Gramineae) in Malesia. Notes on Malesian Grasses VI, *Blumea* 21:1-80. 1973.

Annual or perennial caespitose, rhizomatous, or stoloniferous grasses; leaf blades usually flat and lax; ligules membranaceous, sometimes ciliate. Inflorescence of several to many unilateral racemes, these whorled or racemose along a central rachis; rachis of racemes triquetrous or flattened and winged, the spikelets appressed in 2 rows along the lower side of the rachis, in pairs or triads, rarely solitary or in groups of 4-5; pedicels of each group of unequal length. Spikelets ovate or lanceolate, dorsally compressed, planoconvex, disarticulating below the glumes, placed with the back of the fertile lemma toward the rachis; first glume a minute nerveless scale or absent; second glume from ca. one-fourth as long to as long as the spikelet, usually 3-5-nerved; lower floret represented by a sterile lemma possessing a minute palea which remains attached to the base of the fertile upper floret; sterile lemma usually about as long as the spikelet, flat on the back, 5-9-nerved; fertile floret about as long as the spikelet, its lemma stiff but not rigid, ovate or lanceolate, convex, usually faintly 3-nerved and longitudinally striate, glabrous, grayish, tan, brown, or chocolate colored, its margins thin and flat, not inrolled, overlapping the margins of the palea and often meeting near the base; palea flat, of the same texture and appearance as the lemma and about as long; anthers 3; stigmas 2; caryopsis planoconvex, elliptical, whitish and opalescent.

A large genus of about 170 species (Veldkamp, 1973) of grasses of tropical and warm temperate climates, abundant in both eastern and western hemispheres. *Digitaria* is related to *Leptoloma*, *Reimarchloa*, *Hymenachne*, and *Leptocoryphium*, and less closely to *Panicum* and *Paspalum*. Many of the species of *Digitaria* are abundant weeds of cultivated or waste areas, and a few are cultivated for forage, notably *D. decumbens* (pangola grass) in Central America. Species of *Digitaria* are usually easily recognizable by the very slender simple racemose inflorescence branches and narrow, more or less pointed spikelets. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Digitaria*

- 1a. Mature fertile floret reddish brown to nearly black 2
- 1b. Mature fertile floret grayish or dull tan 6
 - 2a. Spikelets paired, densely covered with elongated silky or tan hairs which nearly conceal the spikelet and extend several mm. beyond the tip
D. insularis
 - 2b. Spikelets paired or in triads, the white, golden, or purple hairs short, not extending more than 1 mm. beyond tip of spikelet 3
- 3a. Spikelets paired; hairs of mature spikelet purple. *D. pittieri*
- 3b. Spikelets in triads or, rarely, 4-5 per group; hairs silvery or golden 4
 - 4a. Margins and tip of sterile lemma bearing stiff, glassy, golden bristles which, when young, extend beyond the tip of spikelet as a stiff brush *D. argillacea*
 - 4b. Margins of sterile lemma and second glume bearing fine appressed silky hairs; golden bristles not present 5
- 5a. Hairs of second glume and sterile lemma with blunt, club-shaped tips, readily visible under 20 × magnification *D. filiformis* var. *villosa*

- 5b. Hairs of second glume and sterile lemma tapering to fine points, hair walls minutely roughened (visible under 400 × magnification) *D. violascens*
- 6a. Spikelets 2 mm. or more long; first glume present or absent 7
- 6b. Spikelets less than 1.5 mm. long; second glume and sterile lemma completely covering fertile floret; first glume absent *D. longiflora*
- 7a. First glume absent; second glume less than half as long as spikelet . *D. setigera*
- 7b. First glume present; second glume more than half as long as spikelet 8
- 8a. Pedicellate spikelet when mature, bearing strongly spreading fine marginal cilia, often interspersed with thick bristles; subsessile spikelet similar or usually with appressed pubescence only *D. bicornis*
- 8b. Spikelets never possessing strongly spreading cilia; spikelets of each pair always alike 9
- 9a. Second glume and sterile lemma subequal, nearly or completely covering and concealing fertile floret 10
- 9b. Second glume shorter and narrower than sterile lemma, exposing upper part and sides of fertile lemma 11
- 10a. Spikelets 3.5-4.0 mm. long; foliage heavily villous; inflorescence a whorl of closely ascending racemes *D. costaricense*
- 10b. Spikelets 1.9-2.1 mm. long; foliage more or less pubescent; inflorescence a panicle of solitary or paired spreading racemes along a slender rachis
D. abyssinica
- 11a. Rachis of racemes bearing scattered elongated pustulose-based hairs 13
- 11b. Rachis of racemes not bearing elongated hairs 12
- 12a. Back of sterile lemma visibly 5-nerved, internerves scarcely wider than nerves; coarse stoloniferous perennial, sometimes with rhizomes; leaf blades narrowly linear, scabrous; cultivated crop *D. decumbens*
- 12b. Back of sterile lemma visibly 3-nerved, internerves broad, first pair of lateral nerves appearing marginal; plants with decumbent stems; leaf blades short and broad, papillose-pilose; wild plants *D. ciliaris*
- 13a. Spikelets 1.8-2.0 mm. long; inflorescence of branched racemes; sterile lemma 5-nerved *D. velutina*
- 13b. Spikelets 2.1-2.4 mm. long; inflorescence of simple, unbranched racemes; sterile lemma 7-nerved *D. horizontalis*

Digitaria abyssinica (Hochst.) Stapf, Gr. Brit. Somal. Kew Bull. 1907:213. *Panicum abyssinicum* Hochst., in A. Rich., Tent. Fl. Abyss. 2:360. 1851. *Syntherisma abyssinica* (Hochst.) Newbold, Torreyana 24:8. 1924. Figure 58.

Duration indefinite; culms long-decumbent and rooting at the nodes, the erect branches 20-40 cm. tall; plants branching freely from the base and from nodes of rooted stems; culms 1.0-1.5 mm. thick, hollow, glabrous, often purple; nodes prominent; prophylla 20-30 mm. long; sheaths shorter or longer than the internodes, papillose-pilose; ligules 1-2 mm. long, membranaceous, erose, brownish or purplish; blades rather short and broad, 4-9 cm. long, 3-11 mm. wide, papillose-pilose on both sides, rounded to a broad base. Peduncles slender, glabrous, exserted up to 15 cm., terminal on the main culm or on erect leafy branches; inflorescence an open panicle of racemes, 5-10 cm. long, wider than long, the rachis 2-6 cm. long, the racemes solitary or subopposite; rachis of

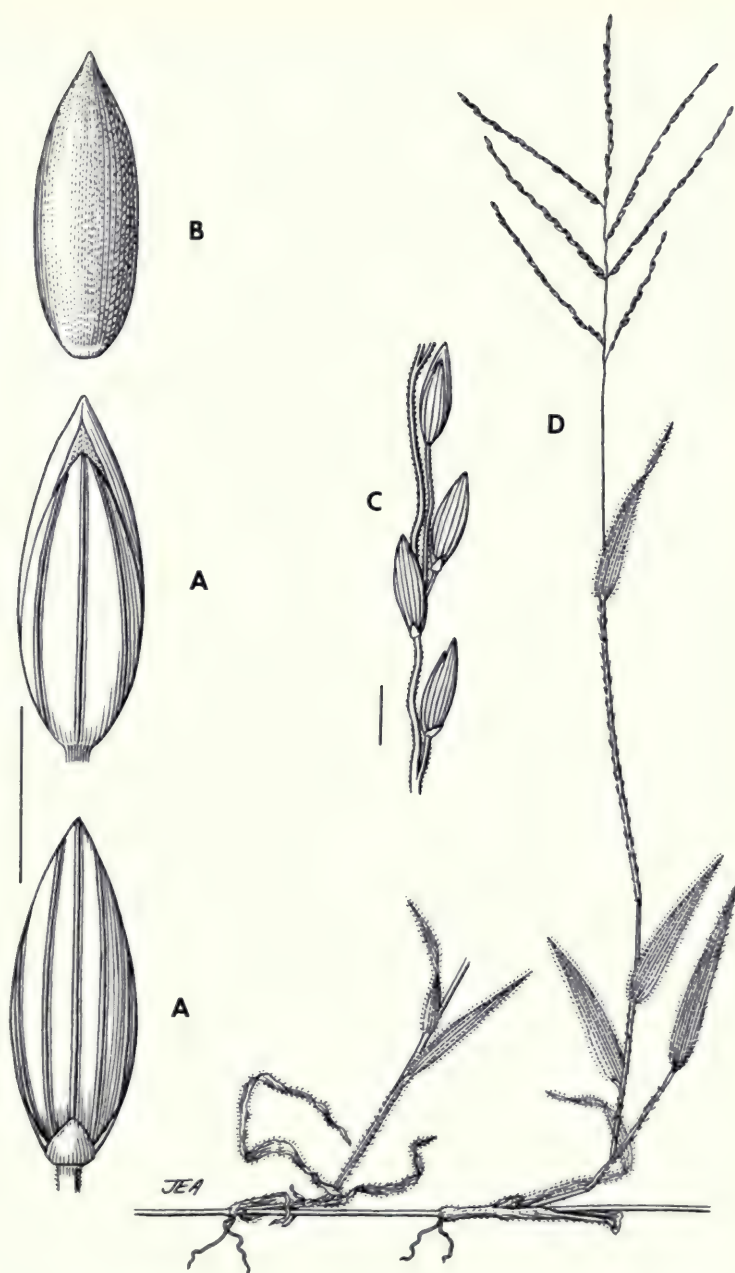


FIG. 58. *Digitaria abyssinica*. A, two views of a spikelet; B, fertile floret; C, portion of a raceme; D, blooming plant.

racemes slender, triquetrous, scabrous on the angles, less than 0.5 mm. thick; spikelets paired, unequally pedicellate, the shorter pedicel 0.8-1.1 mm. long, the longer one 1.7-2.5 mm. long. Spikelets ovate, rather plump, barely acute, 1.9-2.1 mm. long, often with some purple coloration; first glume prominent, ovate-deltoid, 1-nerved, 0.3-0.7 mm. long; second glume ovate, blunt, ca. five-sixths as long as the spikelet, 1.6-1.8 mm. long, 3-6-nerved; sterile lemma as long as the spikelet and slightly exceeding the fertile one, 7-nerved, but the inner 3 nerves much more conspicuous, glabrous or with short silky pubescence on the upper margins; fertile lemma ovate, plump, minutely striate, usually grayish, 1.7-1.9 mm. long, the palea exposed at maturity; anthers 3, orange or purplish, 1.0-1.1 mm. long; stigmas purple; caryopsis elliptical, whitish-opalescent, 1.3-1.4 mm. long. Chromosome number $n = 18$ from a Costa Rican specimen.

Becoming common in disturbed areas, particularly in cafetals; Meseta Central, Orosi and Turrialba Valleys; probably blooming yearlong. Native to northeastern and Central Africa and there known as a weed in coffee plantations; not previously known from the western hemisphere, except as a cultivated introduction in the United States (Newbold, 1.c.).

Henrard distinguishes this species from *D. vestita* Fig. & De-Notaris, but Stapf, in Fl. Trop. Africa 461 (1919), included *D. vestita* as a synonym of *D. abyssinica*. Our specimens seem very uniform except for the slight ciliation of the second glume and sterile lemma of some specimens.

Digitaria argillacea (Hitchc. & Chase) Fernald, Rhodora 22:104. 1920. *Syntherisma argillacea* Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:296. 1917. Figure 61.

Duration indefinite; plants 28-60 cm. tall, the culms erect, in small tufts; culms slender, 1 mm. thick, hollow, glabrous; sheaths papillose-pilose, about as long as the internodes; ligule a lacerate, ciliolate membrane, 0.7-1.2 mm. long; blades flat, 4-9 cm. long, 2-5 mm. wide, papillose-pilose. Peduncle included or exserted, glabrous. Inflorescences solitary, terminal on leafy culms, 6-12 cm. long, of 2-6 erect or spreading racemes along a common rachis 1-3 cm. long; individual racemes 1-12 cm. long, the rachis slender, 0.2-0.3 mm. wide, triquetrous, strongly scabrous and sometimes with scattered elongate hairs; spikelets in triads or pairs, the shortest pedicel 0.5-1.0 mm. long, the longest up to 2.5 mm. long. Spikelets 1.7-1.8 mm. long, not including the bristles, ovate, acute; first glume absent; second glume triangular, 1.2-1.6 mm. long, 3-nerved; sterile lemma as long as the spikelet, 5-7-nerved; central internerve areas glabrous, the lateral ones pubescent with fine silky hairs which are mostly hidden by abundant thick, glassy golden bristles which, until full maturity, are appressed and overtop the spikelet bracts up to 1 mm.; similar bristles on the margins and tip of the second glume; bristles finally widely spreading at maturity of the fruit; tips of bristles slightly dilated and terminating in an abruptly acuminate point; fertile floret plump, ovate, 2.3:1, deep brown, striate; palea similar; caryopsis elliptic, whitish-opalescent, 1.3 mm. long.

Open dry areas, savannas; rare; elevations from sea level to 1,200 m.; Bagaces, Hacienda Argentina, Carillos de Poás, Puntarenas, Boruca, San José. August to December.

This species was originally described from Puerto Rico and has been recorded from Cuba as well as Central America. The type from Puerto Rico has mostly basal foliage, but the spikelets are a good match for our specimens. Our specimens have leafy culms and are vegetatively a good match for *D. hirsuta* Swallen, Ann. Missouri Bot. Gard. 30:172. 1943. The latter species, however, lacks the conspicuous glassy golden bristles found on the spikelets of *D. argillacea*. Spikelets of both species have peculiar bulbous-tipped hairs ending in a sharp mucro. Both of these entities need more field study to determine whether they are actually distinct. *Digitaria hirsuta* may be a form of *D. argillacea* lacking the glassy golden bristles. Similar occurrences are known in other species of the genus.

Digitaria bicornis (Lam.) Roem. & Schult., Syst. 2:470. 1817. *Paspalum bicornis* Lam., Tabl. Encycl. 1:176. 1791. *Digitaria diversiflora* Swallen, Rhodora 65:356. 1963. An extended synonymy for this species is given by Veldkamp in Blumea 21:30-31. 1973. Figure 59.

Duration indefinite; culms long-decumbent and rooting at the nodes, the erect branches 10-85 cm. long, branching from the lower nodes; culms 1-2 mm. thick, hollow, glabrous; leaf sheaths longer or shorter than the internodes, bearing scattered elongate pustulose-based hairs, sometimes nearly glabrous; ligule a thin membrane, 1.5-3.2 mm. long; leaf blades 3-14 cm. long, 2-9 mm. wide, flat, nearly glabrous except for elongated pustulose-based bristles on the upper surface near the base. Peduncles glabrous, exerted up to 30 cm.; inflorescences terminal on the main culm or erect leafy branches, usually consisting of a single whorl of 3-6 racemes, rarely with a secondary whorl above these; racemes 5-14 cm. long, the rachis flattened, wing-margined, 0.7-1.0 mm. wide, the edges scabrous, the midrib winged; spikelets paired, unequally pedicellate, the shorter pedicel ca. 0.2 mm. long, the longer one up to 2 mm. long. Spikelets lanceolate, usually of 2 kinds; length 2.9-3.3 mm.; first glume small to obsolete, deltoid or bifid, 0.2-0.4 mm. long; second glume 1.5-2.2 mm. long, 3-nerved, triangular 6:1, ciliate; sterile lemma as long as the spikelet, 5-nerved; lemma of fertile floret ovate, 6:1, acute, 3-nerved, grayish to stramineous, the palea equal to the lemma; anthers 3, purple, 0.5-0.6 mm. long; caryopsis tan to whitish, opalescent, elliptical-ovate, 1.8-1.9 mm. long; subsessile spikelet usually slightly marginally ciliate, the nerves of the sterile lemma equidistant; pedicellate spikelet strongly ciliate, the hairs divergent at maturity, arising between the lateral nerves of the sterile lemma and on its margins; silky pubescence interspersed with yellowish papillose-based bristles; inner nerves of sterile lemma distant from the midnerve, so that only 3 nerves are normally visible, the others obscured by the pubescence. Chromosome number $n = 36$ from a Costa Rican specimen.

Beaches, sand bars, roadsides, disturbed open areas; sea level to 1,600 m.; common in Guanacaste and on Pacific beaches; Limón; apparently less common in the interior. Probably blooming yearlong. Florida and southern Texas southward to Costa Rica; West Indies; Colombia and Venezuela.

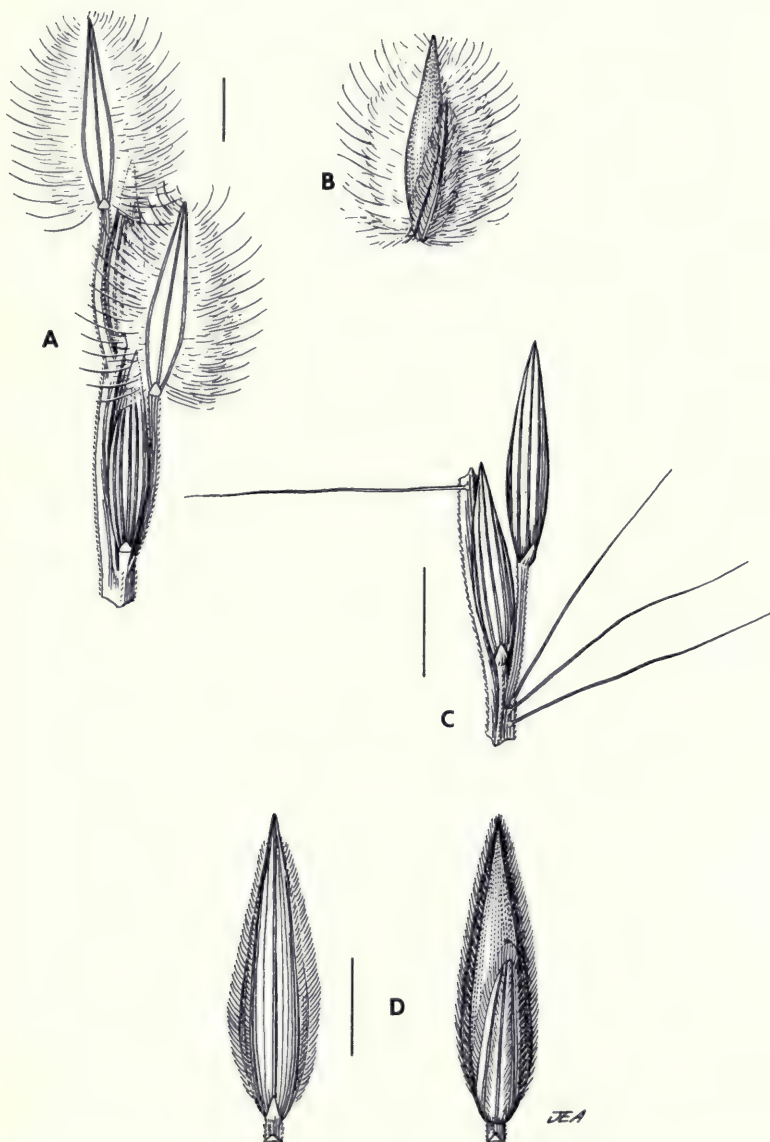


FIG. 59. *Digitaria* species. *D. bicornis*: A, two rachis internodes, showing glabrous subsessile spikelets paired with strongly ciliate pedicellate ones; B, a single spikelet; *D. horizontalis*: C, a spikelet pair, rachis bearing papillose-based hairs; *D. ciliaris*: D, two views of a spikelet.

Digitaria ciliaris (Retz.) Koel., Descr. Gram. 27. 1802. *Panicum ciliare* Retz., Obs. 4:16. 1786. *Panicum sanguinale* auct., non L. *Digitaria adscendens* (H.B.K.) Henr., Mon. Digitaria 9. 1950. *Digitaria abortiva* Reeder, J. Arnold Arbor. 29:291. 1948. An extended synonymy is provided by Veldkamp, l.c. Figure 59.

Duration indefinite; plants mat-forming, the culms long-decumbent, rooting at the nodes; erect portions 30-60 cm. long; branching abundant from the decumbent portions of the culms; prophylla 2 cm. long, with extra marginal nerves; their margins silky pilose; culms ca. 2 mm. thick, hollow, thin-walled, glabrous; sheaths longer or shorter than the internodes, more or less papillose-pilose; ligules membranaceous, 2.0-3.5 mm. long; blades flat, 5-12 cm. long, 5-9 mm. wide, more or less papillose-pilose, especially toward the base. Peduncles exserted up to 27 cm., glabrous; inflorescence 7-15 cm. long, of 2-10 spreading racemes, each 7-14 cm. long, borne in 1 or 2 whorls, the common rachis up to 2 cm. long. Spikelets paired, unequally pedicellate, the shorter pedicel 0.5-1.0 mm. long, the longer 2.0-3.1 mm. long; rachis narrowly winged, scabrous on the angles; spikelets of each pair alike, 2.7-3.4 mm. long, narrowly ovate, 4:1; first glume deltoid, nerveless, 0.3-0.5 mm. long; second glume triangular 4:1, 1.7-2.0 mm. long, 3-nerved, the margins and tip silky; sterile lemma the length of the spikelet, 3-5-nerved, short-silky between the lateral nerves and on the margins; fertile lemma slightly shorter, 2.5-3.0 mm. long, grayish, striate; anthers 3, brownish red, 1.2-1.3 mm. long; stigmas purple. Chromosome number $n = 27$.

Roadsides and open areas, sea level to 1,500 m. elevation, Pacific and Caribbean slopes. April to August, possibly yearlong. Tropics of both hemispheres; in the New World extending from the southern United States to Argentina.

Digitaria costaricensis Pohl, Fieldiana, Bot. 38:5. 1976. Figure 60.

Probably perennial; plants with long decumbent rooting culm bases, up to 80 cm. long, sometimes becoming buried and appearing rhizomatous; culms branching abundantly from lower and middle nodes, 1-3 mm. thick, hollow, thick-walled, glabrous; prophylla up to 2 cm. long, papillose-pilose; sheaths mostly longer than the internodes, densely retrorsely papillose-pilose, the hairs silky, up to 3.5 mm. long; ligule a thin erose membrane, decurrent on the sheath margins, 1.5-2.5 mm. long; blades soft, flat, 8-15 cm. long, 3.5-7.0 mm. wide, softly velvety. Peduncle glabrous, exserted up to 15 cm.; inflorescences terminal on erect leafy branches, 7-14 cm. long, narrow and erect, the 4-7 racemes borne on a short rachis up to 2-3 cm. long; several short racemes of 1-several spikelets borne at the base of the longer racemes. Spikelets paired, rather remote on the slender triquetrous rachis which is strongly scabrous on the angles; subsessile spikelet reaching about to the base of the spikelet next above it; spikelets of the pair equal, 3.5-4.0 mm. long; shorter pedicel 0.5-0.7 mm. long, the longer one 2.0-3.0 mm.; spikelets acute, narrowly ovate 3.4-4.2:1; first glume a thin evanescent nerveless truncate cuff-like scale, ca. 0.3 mm. long; second glume and sterile lemma equal, slightly longer than the fertile floret; both with short silky white hairs on the margins and in the outer internerves, somewhat silky on the back above the base and with scattered silky hairs on the remainder of the back; second glume slightly narrower than the sterile lemma, but covering the fertile floret completely, 5-7-nerved; sterile lemma similar, 7-9-nerved, the nerves equidistant; fertile floret 3.0-3.2 mm. long, the lemma narrowly ovate, acute,

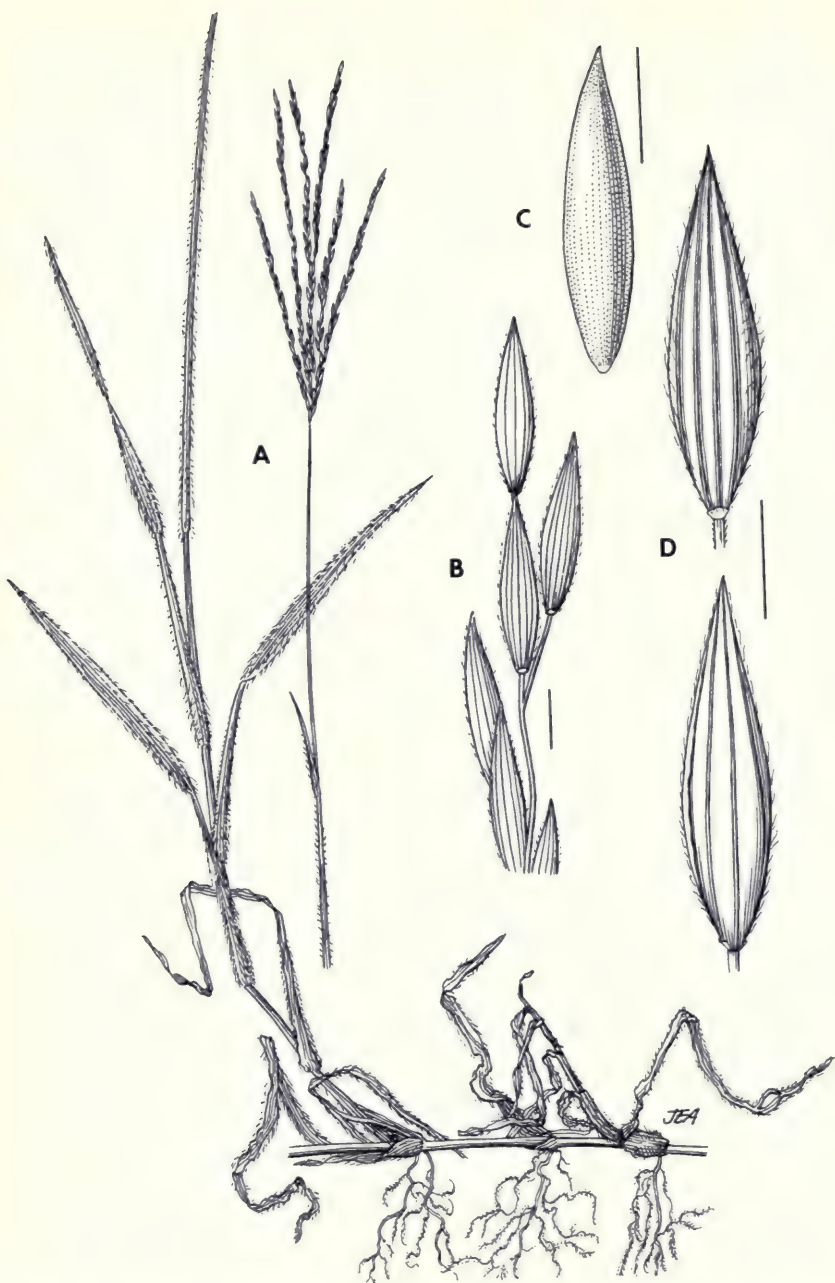


FIG. 60. *Digitaria costaricensis*. A, blooming plant; B, portion of a raceme; C, fertile floret; D, two views of a spikelet.

striate, grayish, faintly 3-nerved, the palea equal; stamens 3, the anthers purple, 0.9-1.5 mm. long; stigmas purple. Mature fruit not seen.

This species occurs at middle elevations in the region east and south of Cartago. It is a member of the section *Aequiglumae* Henrard, Monog. Digitaria 641. 1950. This is a group of about 16 species native to the American tropics and subtropics, the members having paired spikelets with the first glume weak or absent. The second glume and sterile lemma are subequal and usually exceed the fertile floret. Among this group, *Digitaria costaricensis* seems most closely similar to *D. aequiglumis* (Hack. et Arech.) Parodi, from which it differs in the following characteristics: heavily pubescent foliage, wider leaf blades, longer racemes, presence of a cuff-like first glume on the spikelets, more numerous nerves of the second glume and sterile lemma, longer anthers.

***Digitaria decumbens* Stent, Bothalia 3:150. 1930.**

Plants perennial; culms 60-100 cm. long, branching intravaginally from the lower and middle nodes, glabrous, thin-walled, hollow, 2-3 mm. thick; bases often long-decumbent and rooting; prophyllum firm, strongly keeled, up to 3 cm. long; upper internodes very elongated; sheaths mostly shorter than the internodes, glabrous or more or less papillose-pilose above the node and near the apex; ligule membranaceous, minutely erose-ciliate, 1.8-2.5 mm. long; blades flat, firm, narrow, acuminate, somewhat keeled near the base, 5-20 cm. long, 3-6 mm. wide, scabrid. Peduncle exserted 5-25 cm., glabrous, felty-puberulent at the apex; inflorescences terminal on leafy branches, usually composed of a single whorl of 5-7 spreading racemes, these 12-16 cm. long; rachis of racemes triquetrous, 0.5 mm. wide, the green herbaceous margins narrower than the whitish midrib, conspicuously scabrous on all the angles; pedicels triquetrous, scabrous; spikelets paired, or rarely solitary by abortion, unequally pedicellate, the shorter pedicel ca. 0.5 mm. long, the longer one up to 2.2 mm. Spikelets of the pair 3.0-3.5 mm. long, alike; first glume a deltoid to narrowly triangular nerveless scale; second glume one-half to two-thirds as long as the spikelet, lanceolate, ciliate; sterile lemma as long as the spikelet, 3.0-3.5 mm. long, lanceolate, acute, with 5 evident nerves and 2 inconspicuous marginal ones; margins of the lemma and the second internerve from the midrib appressed silky; fertile lemma chartaceous, grayish, very inconspicuously nerved, lanceolate, acuminate; palea equal, both striate; anthers 3, purple, 1.2-1.6 mm. long; pollen collapsed and empty; stigmas purple; lodicules 2, fleshy, truncate. *Digitaria decumbens* is a sterile triploid, its somatic chromosome number being $2n = 27$ from Costa Rican specimens.

This species is widely cultivated in Costa Rica as a forage grass at low and intermediate altitudes, up to 2,000 m. It is especially common in Guanacaste. Introduced from Africa; cultivated or straying from fields by vegetative spread.

Since *D. decumbens* sets no seed, it is propagated by transplanting the stolons. The common name is *Pangola*.

***Digitaria filiformis* (L.) Koel., Descr. Gram. 26. 1802. var. *villosa* (Walt.) Fernald, Rhodora 36:19. 1934. *Panicum filiforme* L., Sp. Pl. 57. 1753. *Syntherisma villosa* Walt., Fl. Carol. 77. 1788. *Digitaria villosa* (Walt.) Persoon, Syn. 1:85. 1805. Figure 61.**

Duration indefinite; plants caespitose, erect; culms slender, glabrous; nodes glabrous; sheaths shorter than the internodes, the lower ones papillose-hirsute, the upper glabrous; ligule a conspicuously ciliate membrane, 1.2-1.5 mm. long; blades narrow, 3-6 mm. wide, elongate, the upper surface with scattered elongate pustulose-based hairs. Peduncle slender, glabrous, exserted; inflorescences solitary, terminal, 9-11 cm. long, of 3-7 ascending racemes, each 6-8 cm. long; spikelets usually in triads, the pedicels of unequal length. Spikelets elliptical-ovate, acute, 2.0-2.2 mm. long; first glume absent; second glume ca. half as long as the spikelet, ovate, 3-nerved, ciliate with short hairs with club-shaped blunt tips, these conspicuous against the dark brown back of the mature fertile lemma; sterile lemma as long as the spikelet, 5-nerved, the central internerve areas glabrous, the others with appressed hairs similar to those of the second glume; fertile floret ca. 2.0 mm. long, the lemma dark brown, striate, the wide thin margins nearly covering a palea of similar color and texture; anthers 3, purple, ca. 0.9 mm. long.

The above description is based largely on the specimen listed below. The determination is somewhat doubtful, since the only available specimen is inadequate. The club-shaped hairs of the spikelets place it in Henrard's group *Clavipilae*, along with such species as *D. filiformis* and *D. leucocoma* (Nash) Urban. Our specimen differs from typical *D. filiformis* of temperate North America in its larger spikelets and from *D. villosa* in having glabrous medial internerves on the sterile lemma and in its shorter, denser racemes. Unless more adequate specimens are collected, we cannot be sure of its identity. San José, San José, 1,100 m., *Hitchcock 8498*, 22-24 October 1911.

***Digitaria horizontalis* Willd., Enum. Pl. 92. 1809. Figure 59.**

Duration indefinite; plants sprawling, the culms long-decumbent and rooting at the lower nodes, branching freely from the lower nodes; prophylla prominent, 1.5-3.5 cm. long; culms ca. 2 mm. thick, hollow, the internodes glabrous and shining; nodes rather prominent; foliage soft, sheaths longer than the internodes, papillose-pilose, less so toward the top of the plant; ligule a thin brownish membrane, 1.5-1.8 mm. long; blades flat, 3-14 cm. long, 3-9 mm. wide, velvety. Peduncle slender, exserted up to 25 cm., glabrous; inflorescences solitary and terminal on the main culm or on leafy branches; panicle up to 15 cm. long, very broad, the elongated slender racemes 4-12 cm. long, borne on a common rachis up to 4 cm. long, the lower ones whorled, the upper often paired or solitary; rachis of racemes triquetrous, ca. 0.5 mm. wide, the narrow herbaceous margins narrower than the midrib, scabrous on the angles, bearing scattered elongated, slender, glassy, papillose-based hairs. Spikelets paired, unequally pedicellate, the shorter pedicel 0.3-0.5 mm. long, the longer one 1.3-2.0 mm. long; spikelets narrowly ovate, acute, 2.1-2.4 mm. long; first glume deltoid, 0.1-0.2 mm. long; second glume ca. half as long as the spikelet, 1.0-1.1 mm. long, narrowly triangular, 3-nerved, ciliate on

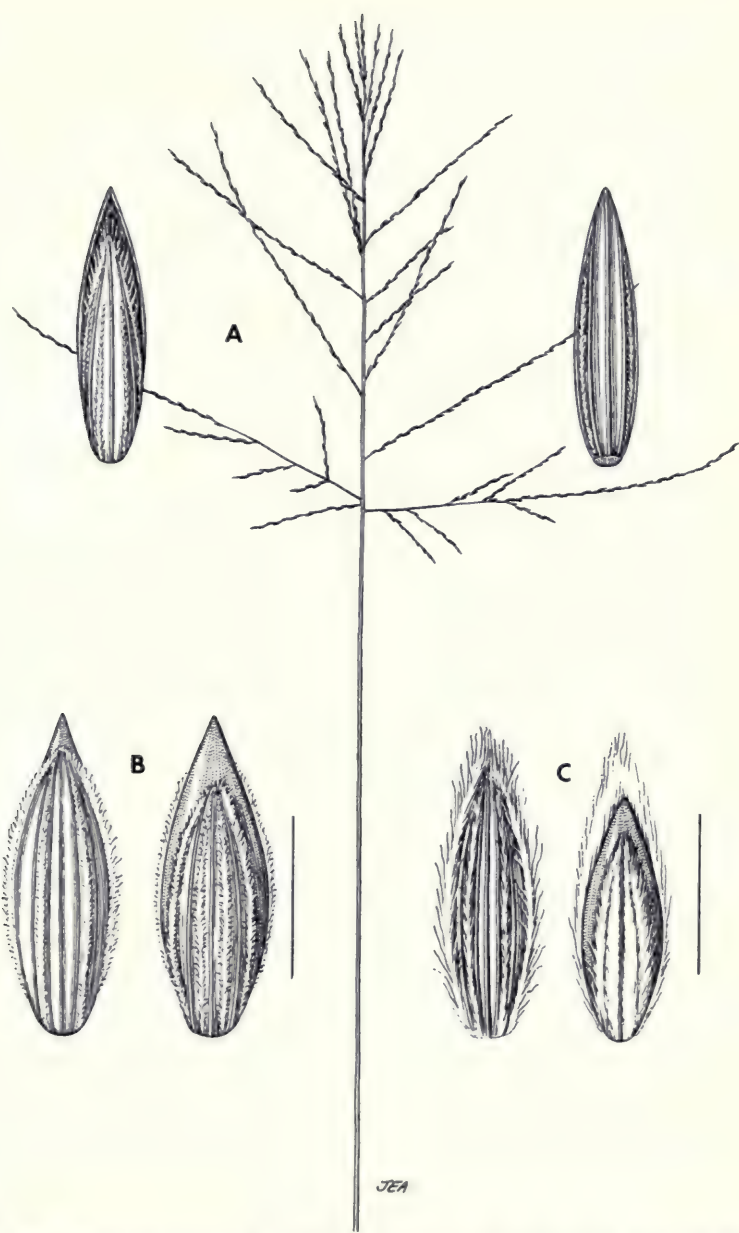


FIG. 61. *Digitaria* species. *D. velutina*: A, panicle and two views of a spikelet; *D. filiformis*, var. *villosa*: B, two views of a spikelet; *D. argillacea*: C, two views of a spikelet.

margins and tip; sterile lemma as long as the spikelet, lanceolate, acute, 7-nerved, ciliate with short, silky hairs; fertile lemma stramineous or grayish, minutely striate, slightly shorter than the sterile lemma; caryopsis lanceolate, tan, ca. 1.8 mm. long. Chromosome number $n = 18$ from Central American material.

Occasional on Caribbean and Pacific beaches, also at Tuís, Puerto Viejo and Siquirres. Blooming July to February, probably yearlong. Southern Florida; West Indies; tropical America from Guatemala to Brazil and Paraguay.

The nomenclature of this species is much confused. Our material has been identified by Veldkamp.

***Digitaria insularis* (L.) Mez ex Ekman**, Beitr. Gramineenfl. Missiones. Ark. Bot. 11:17. 1912. *Andropogon insulare* L., Syst. Nat. ed. 10:2:1304. 1759. *Trichachne insularis* (L.) Nees, Agrost. Bras. 86. 1829. Figure 63.

Vigorous perennial; plants 80-130 cm. tall, erect; bases of culms with swollen, woolly bracted innovations; culms branching from middle and lower nodes, up to 3 mm. thick, hollow, glabrous; nodes glabrous; sheaths mostly papillose-pilose, rarely glabrous; ligules 4-6 mm. long, thin, tan, membranaceous; blades lax, flat, 20-50 cm. long, 10-17 mm. wide, scabrid. Peduncle glabrous, exserted 10-50 cm.; inflorescences terminal on the main culm or on leafy branches, narrow, cylindric, 20-35 cm. long, 2-10 cm. wide; racemes numerous, ascending, mostly 10-15 cm. long, the axis slender, trigonous, scabrous on the angles; spikelets paired, equal, one pedicel 0.7-2.0 mm. long, the other 2.5-5.0 mm. long, both slender, trigonous, scabrous. Spikelets narrowly ovate, caudate, 4.2-4.6 mm. long, densely covered with abundant fawn-colored hairs up to 6 mm. long and extending beyond the summit of the spikelet as much as 5 mm.; first glume membranaceous, nerveless, triangular to ovate; second glume lanceolate, 3.5-4.5 mm. long, 3-5-nerved, ciliate on the margins; sterile lemma as long as the spikelet (4.1-4.5 mm. long), narrowly ovate, acuminate, 7-nerved, the nerves obscured by the dense marginal hairs; fertile lemma narrowly ovate, acuminate, castaneous, minutely striate, 3.2-3.6 mm. long; palea about equal; anthers 3, rarely exserted, 1.0-1.2 mm. long, tan. Chromosome number $n = 18$ from Costa Rican specimens.

Beaches, roadsides and forest margins, pastures; common in Guanacaste, also collected from Pigres, Atenas, Puente de Mulas, and Guacimo; elevations sea level to 1,200 m.; probably blooming yearlong. The plants are somewhat weedy. Florida and southern Texas to Arizona, southward to Argentina; West Indies.

The fertile floret is elevated above the insertion of the second glume and sterile lemma on a thick rachilla internode 0.2-0.4 mm. long. This feature was formerly used as a generic character to separate *Trichachne* from *Digitaria*.

***Digitaria longiflora* (Retz.) Pers.**, Syn. Pl. 85. 1805. *Paspalum longiflorum* Retz., Obs. Bot. IV:15. 1786. Figure 62.

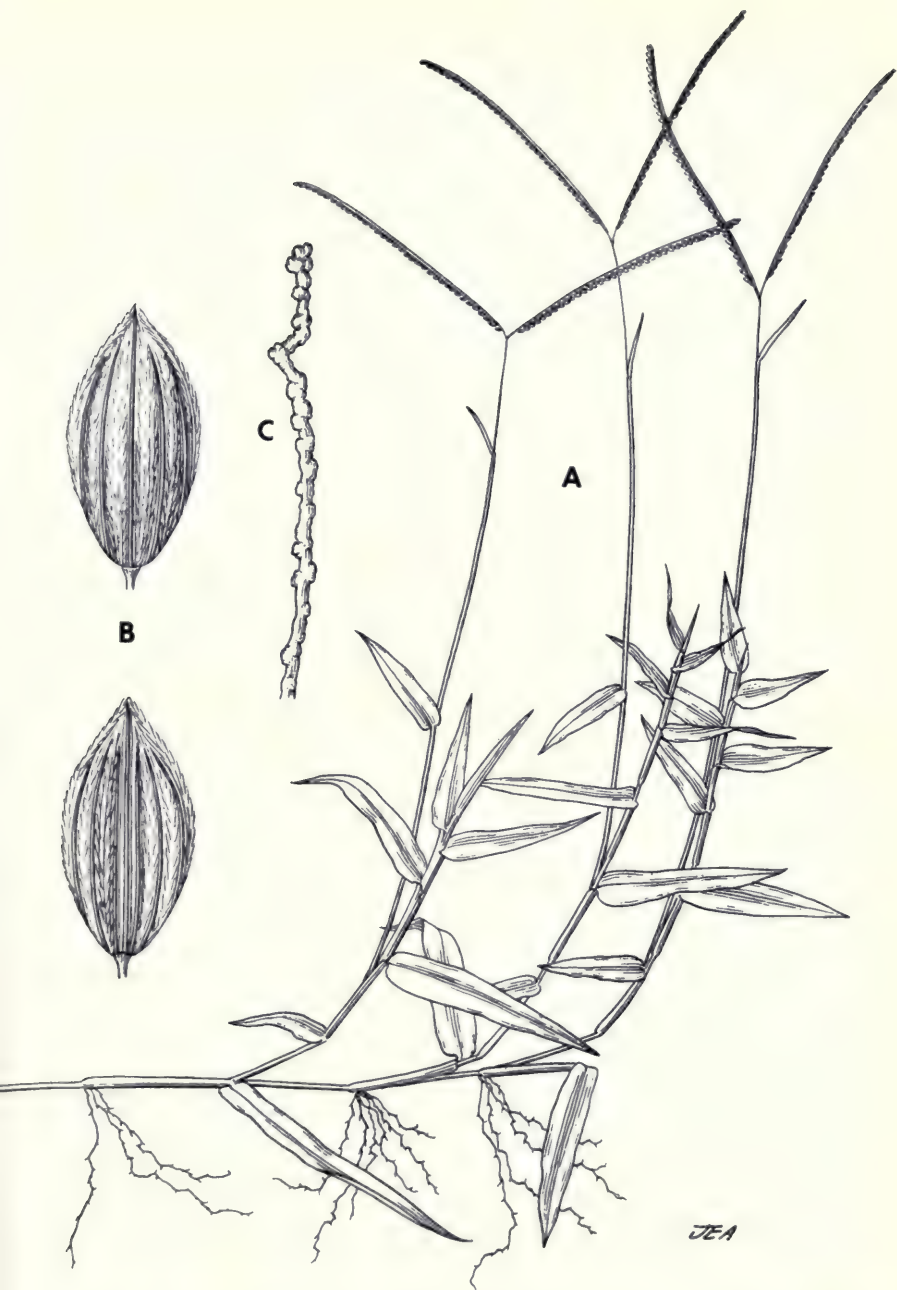


FIG. 62. *Digitaria longiflora*. A, blooming plant; B, two views of a spikelet; C, verrucose hair from a spikelet, greatly enlarged.

Duration indefinite; plants forming large patches by means of long, abundant, freely branching stolons; flowering culms ascending to erect, 10-25 cm. tall, branching occasionally from the lower nodes; culms 1 mm. or less thick, hollow, glabrous; nodes dark, contracted; leaves 3-4 per culm, mostly clustered near the base; lower sheaths overlapping, the internodes short; peduncle very elongated, exserted, forming more than half the height of the plants; ligule a thin whitish membrane, 0.5-1.0 mm. long; leaf blades flat, 1.5-4.0 cm. long, 3-5 mm. wide, 5-8 $\times$ longer than wide, glabrous except for a few small cilia near the subcordate base. Inflorescence of 2 or rarely 3 conjugate slender racemes borne at the tip of the peduncle, widely spreading; racemes 4-5 cm. long; rachis flat, green, ca. 1 mm. wide, naked for 1-2 mm. at the base; spikelets crowded, borne in trios, these alternating along the sides of the narrow midrib. Spikelets of each trio alike, but borne on pedicels of unequal length, elliptic or slightly obovate 2:1, acute at the apex, 1.2-1.3 mm. long; first glume absent; second glume and sterile lemma equal, completely covering the fertile lemma or only its tip exposed; second glume 5-nerved, minutely pubescent between all of the nerves and on the margins; sterile lemma similar but 7-nerved, pubescent on the margins and outer internerves, the internerves adjacent to the midrib glabrous; fertile lemma grayish, ca. 1.2 mm. long, minutely striate, acute at the apex, enclosing a palea of equal length; anthers 3, purple, 0.7-0.8 mm. long; stigmas purple.

Sandy beach of the Caribbean at Tortugero, *Pohl & Lucas 13030*. December. This is apparently the only collection from the mainland of North America. West Indies. Introduced from the Old World; native to Africa and Asia.

Digitaria pittieri (Hack.) Henrard, Monog. Gen. *Digitaria* 570. 1950. *Panicum pittieri* Hack., Oesterr. Bot. Z. 51:367. 1901. *Valota pittieri* (Hack.) Chase, Proc. Biol. Soc. Wash. 19:188. 1906. *Trichachne pittieri* (Hack.) Hitchc., Proc. Biol. Soc. Wash. 40:83. 1927. Figure 63.

Duration indefinite; plants erect or scrambling, the culm bases decumbent and rooting; culms branching freely, ca. 1 mm. thick, hollow, glabrous; prophylla prominent, 2-4 cm. long, thin and soft, with 2 minor nerves marginal to each keel; sheaths loose, longer or shorter than the internodes, more or less papillose-hirsute; blades soft, rather short and broad, 6-10 cm. long, 7-11 mm. wide, flat, more or less papillose-pilose on both sides; ligule membranaceous, 1.0-2.5 mm. long. Peduncle slender, glabrous, exserted up to 25 cm. Inflorescences numerous, terminal on leafy branches, 6-12 cm. long, of 5-10 slender ascending or rarely horizontally spreading racemes borne on a common rachis 1-4 cm. long; rachis and branches slender, triquetrous, bearing scattered, thin, elongate, pustulose-based hairs up to 4 mm. long; spikelets paired, rarely in triads near the base of the raceme, or solitary and accompanied by a minute abortive spikelet; pedicels slender, angular, the shorter one of the pair 0.2-0.3 mm. long, the longer one 1.5-3.0 mm. long. Spikelets dorsally compressed, lanceolate, 3.0-3.7 mm. long, marginally ciliate with soft erect purple hairs, these surpassing the tip of the spikelet up to 1 mm.; first glume obsolete or minute, up to 0.3 mm. long, truncate, deltoid, or bidentate, glabrous; second glume ca. three-fourths as long as the spikelet, narrowly triangular, 3-nerved, 2.0-2.7 mm. long, marginally ciliate with erect hairs; sterile lemma as long as the spikelet, 7-nerved, heavily marginally ciliate with shorter hairs in the internerves; fertile floret lanceolate, 2.8-3.0 mm. long, firm, castaneous, longitudinally striate, acuminate, the

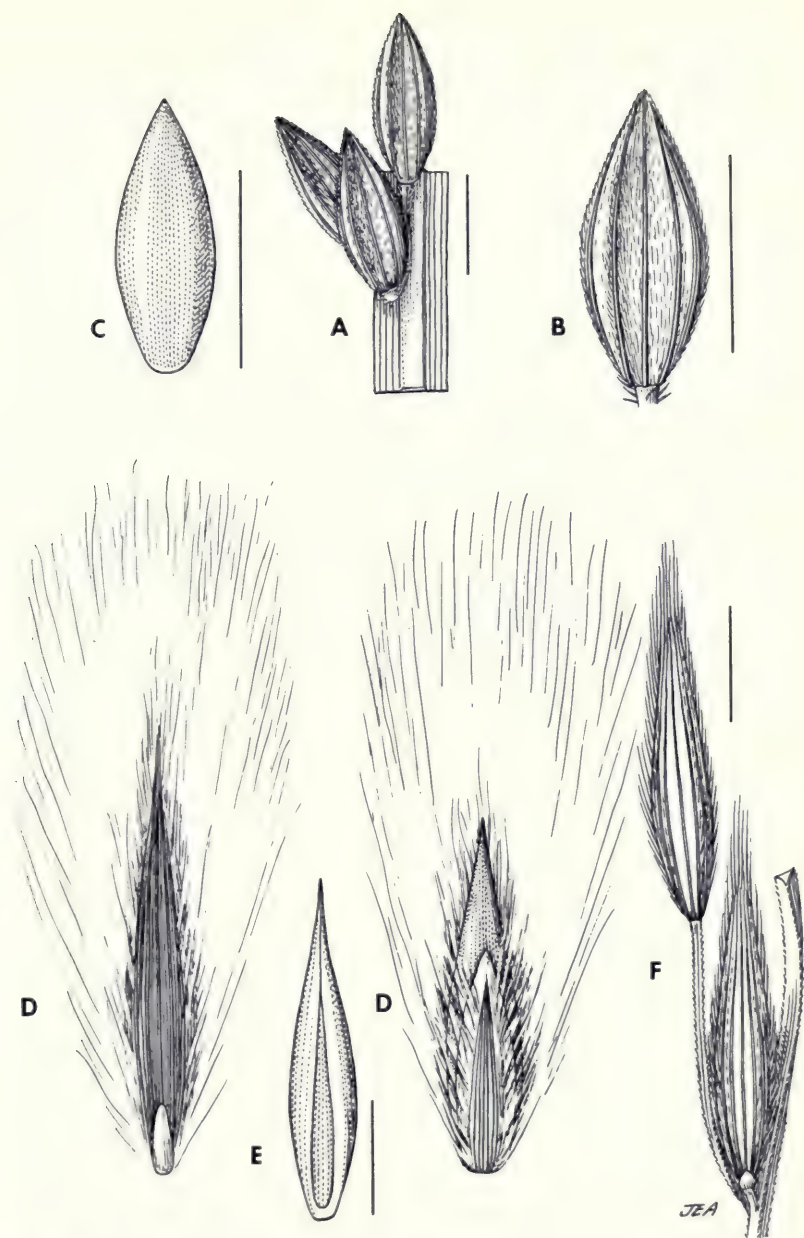


FIG. 63. *Digitaria* species. *D. violascens*: A, spikelet triad; B, spikelet; C, fertile floret; *D. insularis*: D, two views of a spikelet; E, fertile floret; *D. pittieri*: F, spikelet pair attached to the rachis.

margins thin; palea similar in color and texture, ca. as long as the lemma; caryopses produced; anthers 3, tan, 1 mm. long.

Endemic to Costa Rica; rare, Meseta Central and Cartago Valley, 1,000-1,400 m. elevation. Pastures, roadsides, thickets, river banks. September to February.

This species is readily distinguished from others of the genus *Digitaria* by the dense purple marginal hairs of the spikelets. The type number, *Pittier & Durand 6945*, was collected by Tonduz as his number 749, from the banks of the Río Tiliri near San José in 1892. The species was subsequently collected in 1911 at Alajuela and San José, at Dulce Nombre near Cartago in 1924, and at Ujaras in 1936. It has not been collected since, but may persist in the Meseta Central. The elongated shape of the spikelets and their hairiness suggest a relationship to *D. insularis*. The elongated trichomes of the inflorescence branches are similar to those of *D. horizontalis*.

Digitaria setigera Roth ex Roem. & Schult., Syst. Veg. 2:474. 1817.
var. ***setigera*** *D. sanguinalis* auct., non Scop. *D. adscendens* auct., non Henrard. An extensive synonymy is given by Veldkamp, *l.c.*

Duration indefinite; plants forming mats or patches, the culms glabrous, hollow, 1.5-2.5 mm. thick, long-decumbent and rooting at the lower nodes; erect portions of the culms up to 120 cm. long; branching free from lower nodes; prophylla up to 8 cm. long, with multiple lateral nerves; sheaths mostly shorter than the internodes, more or less papillose-pilose; ligule a tan membrane, 2.5-3.5 mm. long; blades flat, 4-28 cm. long, 4-12 mm. wide, usually with a few papillose hairs near the base on the upper surface, sometimes pilose all over, the surfaces usually scabrous. Peduncles long-exserted, up to 40 cm. long, glabrous; inflorescences terminal on leafy branches, usually 10-15 cm. long, composed of 1 to several whorls of racemes borne on a common axis up to 6 cm. long; racemes 3-11, each 5-15 cm. long, spreading; rachis of racemes winged, 0.5-1.0 mm. wide, scabrous on the margins, the midrib keeled. Spikelets paired, unequally pedicellate, the shorter pedicel of the pair 0.3-0.8 mm. long, the longer 1.7-2.7 mm. long; spikelets 2.4-3.5 mm. long, ovate 3:1 to 4:1; first glume absent or a minute cufflike scale 0.1 mm. long; second glume 0.7-1.3 mm. long, less than half the length of the spikelet, rectangular or bilobed at the apex, 1-3-nerved, ciliate, the hairs overtopping the scale; sterile lemma the length of the spikelet, 5-7-nerved, the central pair of nerves remote from the midrib; lateral internerves and margins of the lemma silky-ciliate; fertile lemma slightly shorter than the sterile lemma, tan or grayish, striate, faintly 3-nerved, acuminate, its palea equal in length; anthers 3, reddish brown, 0.7-1.3 mm. long; stigmas purple; caryopsis elliptical, whitish-opalescent. Chromosome number $n = 35, 36$ from Costa Rican specimens.

Occasional in open places and roadsides; Colonia Carmona, San José, Guapiles, Limón, Isla del Coco; sea level to 1,100 m. Caribbean coast of Honduras. Not previously recognized from Central America, but

probably occurring elsewhere in the American tropics. Tropical Asia, Australia, Jamaica, Surinam.

Digitaria velutina (Forsk.) Beauv., Ess. Nouv. Agrost. 51. 1812. *Phalaris velutina* Forsk., Fl. Aegypt. Arab. 17. 1775. Not *D. velutina* (DC) Hitchc., Proc. Biol. Soc. Wash. 40:84. 1927. Figure 61.

Duration indefinite; plants 30-60 cm. tall; bases of culms long-decumbent and rooting, forming circular patches; branching mostly from the rooted basal portions; prophylla 2-keeled, 1.5-2.5 cm. long; culms 1.5-1.8 mm. thick, hollow, thin-walled, glabrous; nodes contracted, glabrous; leaves 1-4 per culm; sheaths shorter or longer than the internodes, papillose-pilose, keeled near the apex; ligule a tan membrane, 1.8-2.0 mm. long; leaf blades thin, flat, 6-10 cm. long, 6-10 mm. wide, appressed-pilose, somewhat keeled near the subcordate base. Peduncle slender, exserted 14-30 cm., glabrous, the interior filled with pith; inflorescences terminal on apical peduncles. Inflorescence paniced, 8-12 cm. long, 10-14 cm. wide, composed of 11-28 slender branches, the lowermost ones usually whorled, the upper ones paired or solitary; lower branches up to 10 cm. long, pinnately branched with spreading branches 2-3 cm. long, the upper branches simple; rachis triquetrous, narrowly winged, scabrous on the angles and bearing scattered long hairs; the spikelets paired, equal, one subsessile, the other on a pedicel up to 1.5 mm. long. Spikelets purplish, 1.8-2.0 mm. long; first glume minute, ca. 0.1 mm. long, or obsolete; second glume 1.5-1.7 mm. long, oblong to ovate, 3-nerved, the internerves villous; sterile lemma as long as the spikelet, 5-nerved, villous on the marginal internerves and edges; fertile lemma exposed near the tip, grayish, faintly nerved, ovate, acute, the margins covering the edges of a slightly shorter palea of similar texture; caryopsis elliptical, whitish-opalescent, 1.2-1.3 mm. long. Chromosome number $n = 9$.

Our only specimen is the following: San José, Ciudad Universitaria, disturbed subsoil in area of new library building. *Pohl & Davidse 11075*, 11 September 1968. Arabia to tropical Africa. Apparently previously unreported from the western hemisphere.

Digitaria violascens Link, Hort. Berol. 1:229. 1827. *Panicum violascens* (Link) Kunth, Rév. Gram. 1:33. 1829. An extended synonymy is given by Veldkamp, Rev. *Digitaria* Malesia 63 (1972). Figure 63.

Duration indefinite; plants erect, in small tufts; culms mostly unbranched, slender, ca. 1 mm. thick, hollow, thin-walled, glabrous; nodes glabrous, not prominent; foliage mostly basal, the uppermost leaf blade reduced; sheaths shorter than the internodes, glabrous; ligule an erose membrane 1.0-2.3 mm. long; blades few per culm, 4-17 cm. long, 3-5 mm. wide, glabrous, sometimes scaberulous on the upper surface or with a few elongated papillose-based hairs on the upper surface near the base. Peduncle slender, exserted up to 13 cm.; inflorescences solitary and terminal on leafy culms, 3-10 cm. long, consisting of 2-7 slender, arching racemes borne in 1-2 whorls, the common rachis up to 3 cm. long; rachis of racemes flattened, 0.5-0.7 mm. wide, with a herbaceous border, the edges scabrous. Spikelets usually borne in triads, occasionally 4 or 5 together and rarely solitary by abortion of spikelets; pedicels of varying length, the shortest of the triad

0.2-0.3 mm. long, the middle one 0.8-1.0 mm., the longest 1.3-2.0 mm. long, scabrous, the apex dilated into a disk. Spikelets of each group equal, ovate 2:1, 1.4-1.5 mm. long, first glume absent, the second glume and sterile lemma thin, white; second glume 1.3-1.4 mm. long, slightly shorter and narrower than the spikelet, usually 3-nerved, rarely 5-nerved, the nerves anastomosing near the tip; sterile lemma as long as the spikelet, usually 5-nerved, rarely 7-nerved; internerves of the sterile lemma and second glume bearing appressed white silky hairs, their walls verrucose-roughened under $400\times$ magnification; fertile floret about as long as the spikelet, deep chestnut brown at maturity; lemma minutely striate, faintly 3-nerved; palea similar; caryopsis elliptical, 1.0-1.1 mm. long, white, opalescent; anthers 3, reddish, 0.4-0.6 mm. long. Chromosome number $n = 18$ from Costa Rican specimens.

Open roadsides and waste ground, sea level to 1,500 m. elevation; San José area, General Valley, San Vito, Golfito. Blooming yearlong. Tropics of Asia and Australia; introduced in the western hemisphere.

This species may be confused with *D. panicea* (Sw.) Urban, which differs by having a narrow triquetrous rachis, spikelets bearing capitate hairs, and ciliolate ligules.

ECHINOCHLOA Beauvois

REFERENCES: F. W. Gould, M. A. Ali, & D. E. Fairbrothers, A revision of *Echinochloa* in the United States, Amer. Midl. Naturalist 87:36-59. 1972. A. S. Hitchcock, The North American species of *Echinochloa*, Contr. U.S. Natl. Herb. 22:133-153. 1920. K. M. Wiegand, The genus *Echinochloa* in North America, Rhodora 23:49-65. 1921.

Annual or perennial, caespitose, decumbent, or rhizomatous grasses; culms usually solid, the lumen filled with aerenchyma; ligule absent or consisting of a dense row of stiff hairs. Inflorescence a terminal panicle, the branches mostly simple, bearing paired or clustered sessile spikelets. Disarticulation below the glumes, the spikelets elliptical or ovate, dorsally compressed, plano-convex; first glume one- to three-fourths as long as the spikelet, ovate, apiculate, 3-5-nerved; second glume and lower lemma subequal, as long as the spikelet, apiculate or the lemma bearing a terminal awn; second glume 5-7-nerved, convex, usually hispid on the nerves; lower lemma similar but usually 5-nerved and often tapering into a stiff, antrorsely scabrous awn; lemma containing a well-developed flat, membranaceous palea and in some species a staminate flower; second floret with a shiny, coriaceous, stramineous, longitudinally striate, ovate or elliptical lemma, its flat margins covering the edges of a flat palea of similar texture, except near the emergent tip; tip of lemma apiculate or beaklike; lodicules 2, truncate; stamens 3, the anthers yellow or orange; stigmas 2, plumose, purple.

The species of *Echinochloa* frequent rich, moist, disturbed soil or occur in shallow water. The apiculate or awned spikelets, solid culms, and the usual absence of a ligule are marks of recognition. The genus is

similar to *Panicum* in many respects, differing in the awned or apiculate spikelets and the flat, not inrolled, margins of the fertile lemma. *Echinochloa* is similar to *Hymenachne* in its solid, aerenchymatous culms and hygrophilous habit. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Echinochloa*

- 1a. Ligule a dense row of stiff bristles; lower floret staminate 2
- 1b. Ligule absent; lower floret neuter 3
 - 2a. Plants with short scaly rhizomes; spikelets awnless, 2.9-3.5 mm. long; fertile floret 2.5-2.7 mm. long; anthers 1.0-1.5 mm. long *E. pyramidalis*
 - 2b. Plants not rhizomatous, culms often decumbent and rooting; spikelets 4.5-6.0 mm. long, sometimes with awn up to 18 mm. long; fertile floret 2.5-5.0 mm. long; anthers 1.5-3.6 mm. long *E. polystachya*
- 3a. Spikelets awnless, borne in 4 rows on short racemes 1-2 cm. long; fertile floret 1.9-2.2 mm. long *E. colonum*
- 3b. Spikelets awn-tipped or awned, irregularly crowded along 4-6 cm. long racemes; fertile floret 2.5-2.8 mm. long *E. crus-garonis*

***Echinochloa colonum* (L.) Link, Hort. Berol. 2:209. 1833.**
Panicum colonum L., Syst. Nat. ed. 10. 2:870. 1759. An extended synonymy is given by Gould et al. Figure 64.

Plants annual, erect and caespitose, or spreading and rooting from the lower nodes; culms usually 20-60 cm. tall, 2-3 mm. thick, hollow or filled with aerenchyma, branching near the base; lower nodes appressed-hispid, the upper glabrous; prophylla prominent, up to 8 cm. long; sheaths glabrous, shorter than the internodes, somewhat keeled; ligule absent; blades flat, 8-22 cm. long, 3-8 mm. wide, glabrous or with a few papillose-based marginal setae near the base. Peduncle exserted up to 10 cm.; inflorescence slender, 2-12 cm. long, composed of 5-10 short, spikelike erect or ascending racemes, racemously arranged along the slender, angular, scabrous rachis; individual racemes 0.7-2.0 cm. long, the rachis flattened; spikelets paired, minutely pedicellate, in 4 rows along the lower side of the rachis, which is papillose-hispid at its base and more or less along its length. Spikelets ovate, acute, not awned or barely apiculate, flattened on the first glume side, strongly turgid on the second glume side, often purple-blotched, 2.3-2.9 mm. long, the visible bracts appressed-hispid along the nerves; first glume 1.0-1.5 mm. long, 3-nerved, broadly ovate, acute; second glume very convex, ovate, apiculate, 5-nerved, as long as the spikelet; sterile lemma flat, 5-nerved, as long as the spikelet, concealing an elliptical flat palea nearly as long; fertile lemma 1.9-2.2 mm. long, indurate, smooth and shining, faintly longitudinally striate and 5-nerved, elliptical 3:2, terminating in a minute greenish withering tip; palea flat, its margins overlapped by the flat edges of the lemma except at the tip; anthers 3, yellow, 0.7-0.8 mm. long. Chromosome number $n = 27$ from Costa Rican plants.

Roadsides, pastures, beaches, banana groves, sea level to 1,100 m., but most common at low elevations near the coasts. June to December. Widespread in warm climates of the world, apparently introduced from the Old World. Certain plants may have leaf blades with transverse purple markings.

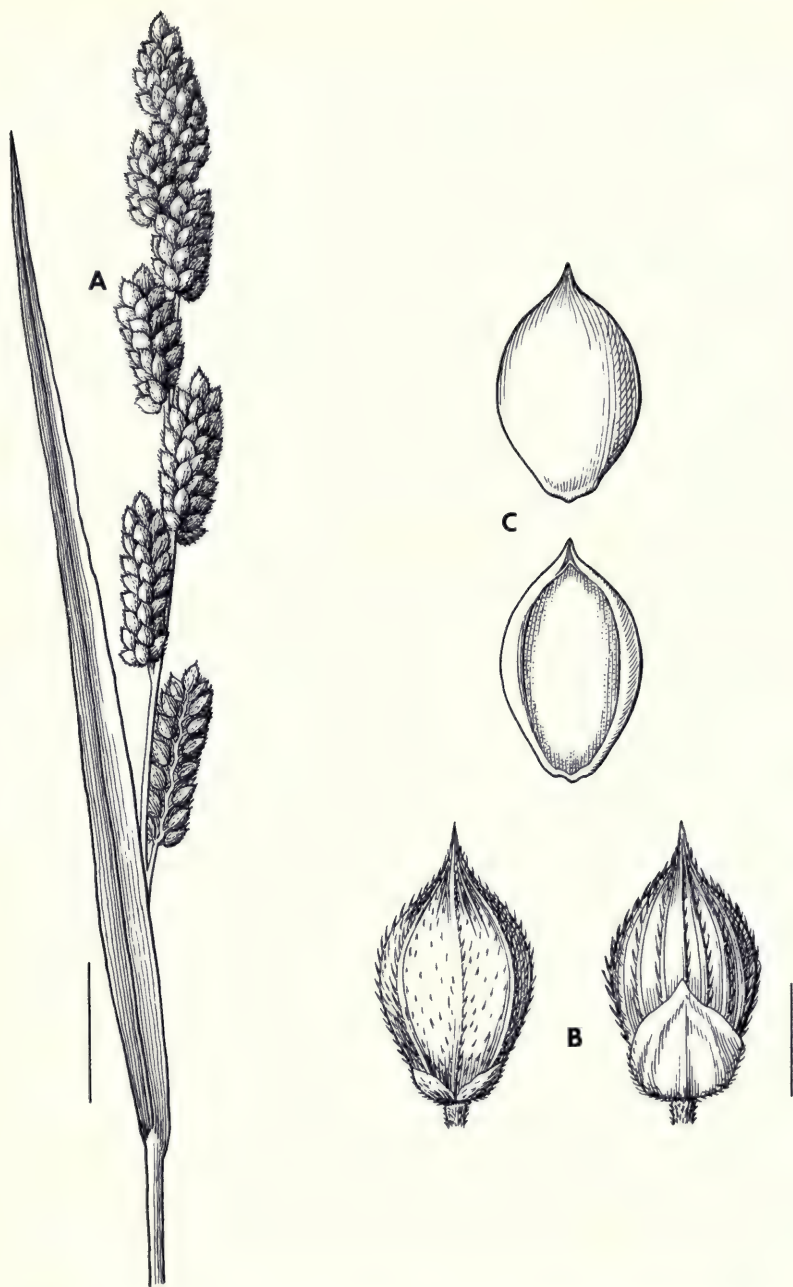


FIG. 64. *Echinochloa colonum*. A, inflorescence; B, two views of a spikelet; C, two views of the fertile floret.

Echinochloa crus-pavonis (H.B.K.) Schult., Mant. Pl. 2:269. 1824. *Oplismenus crus-pavonis* H.B.K., Nov. Gen. & Sp. 1:108. 1816. An extended synonymy is given by Gould et al. Figure 65.

Duration indefinite, probably annual; plants 80-150 cm. tall, the culms erect or the bases decumbent and rooting from the lower nodes, branching from the lower nodes, thick and spongy, often 1 cm. or more thick, glabrous; nodes swollen, glabrous; lumen of internodes filled with aerenchyma which contains vascular bundles; prophylla prominent, up to 12 cm. long; sheaths shorter than the internodes, loose, glabrous, often purplish; ligule absent, a rounded ridge taking its place; blades flat, glabrous, usually 12-60 cm. long, 7-25 mm. wide, scabrous-margined. Inflorescences terminal on the main culm or on erect leafy intravaginal branches, 10-30 cm. long, oblong to narrowly pyramidal, the branches, except the lowermost, mostly overlapping, 4-6 cm. long. Spikelets mostly paired, densely and irregularly clustered along the primary or secondary branches, obscuring the axes; rachis and branches angular, scabrous, often bearing pustulose-based stiff glassy hairs. Spikelets 2.8-3.5 mm. long, often purple, awn-tipped or awned, ovate; first glume 1.4-1.7 mm. long, broadly ovate or orbicular, abruptly acuminate, the margins enwrapping the base of the second glume, 3- or rarely 4-nerved; second glume as long as the spikelet, 5-nerved, ovate, cuspidate, bulging, bearing more or less appressed stiff hairs on the nerves and minutely hispid between them; sterile lemma as long as the spikelet, ovate, 5-nerved, similar to the second glume, enclosing a flat membranaceous elliptical palea two-thirds to three-fourths as long, awn-tipped or bearing a stiff scabrous awn up to 11 mm. long; fertile lemma 2.5-2.8 mm. long, ovate, caudate, shiny, faintly-nerved, tapering into a herbaceous withering tip; palea equal to the lemma and similar in texture; anthers 3, dark, 1.0-1.2 mm. long; lodicules small, truncate. Chromosome number of *E. crus-pavonis* is $n = 18$ from a number of Costa Rican specimens.

Wet open areas and marshes, roadsides; sea level to 1,700 m. elevation. Cartago area, San José, Nuestro Amo, Guanacaste. June to October. Probably common, but little collected. Southern United States to Argentina; tropical Africa; Australia.

This species exhibits a great deal of variation in awn length. Awnless specimens appear very different from long-awned types, but fundamental spikelet structure is the same. This species has been confused with *E. crusgalli* (L.) Beauv., but differs from the latter in the lack of minute bristles at the apex of the shiny part of the fertile lemma, as well as in chromosome number. Var. *macera* (Wiegand) Gould is said to have vestigial or absent palea within the sterile lemma. All of the Costa Rican specimens have a well-developed palea and belong to var. *crus-pavonis*.

Echinochloa polystachya (H.B.K.) Hitchc., Contr. U.S. Natl. Herb. 22:135. 1920. *Oplismenus polystachyus* H.B.K., Nov. Gen. & Sp. 1:107. 1816. Figure 65.

Duration indefinite, probably perennial; culms 1-3 m. or more long, decumbent and rooting abundantly at the lower nodes, sometimes forming large floating patches, gla-



FIG. 65. *Echinochloa* species. *E. crus-pavonis*: A, base of leaf blade, lacking a ligule; B, base of culm; C, inflorescence; D, two views of a spikelet; *E. polystachya*: E, base of leaf blade, showing ligule; F, two views of a spikelet.

brous, spongy, up to 1.5 cm. thick, the lumen filled with aerenchyma containing vascular bundles; nodes glabrous or strongly appressed-hispid, swollen; branching intravaginal from the middle nodes; prophylla prominent, up to 13 cm. long, hispid-margined and with a conspicuous tuft of hispid hairs at the tip; sheaths shorter or longer than the internodes, glabrous or appressed papillose-hispid; ligule a dense V-shaped line of stiff tan hairs, 2-4 mm. long, continued onto the upper sheath margins as a few papillose-hispid hairs; leaf blades soft, flat, up to 50 cm. long and 3.5 cm. wide, with a prominent white midrib, glabrous, the margins scabrous, surfaces scabrous toward the tip. Inflorescences terminal; peduncle ridged, glabrous, up to 15 cm. long; panicle 20-35 cm. long, narrowly cylindrical, 2-5 cm. wide, the numerous ascending branches 2-11 cm. long, rachis angular, scabrous, with tufts of stiff, glassy, papillose-based hairs at the bases of the branches, along the rachises of the branches, and on the pedicels; spikelets subsessile or on pedicels up to 1 mm. long, their apices dilated into disks. Spikelets paired, in trios, or irregularly grouped on the lower sides of the primary branches, 4.5-6.0 mm. long, elliptic or narrowly ovate, apiculate or awned, short-hispid on the nerves, greenish; first glume 1.9-4.2 mm. long, 5-7-nerved, broadly deltoid-ovate, clasping the base of the second glume, its margins minutely ciliate; second glume and lower lemma about equal, as long as the spikelet; second glume convex, 5- or usually 7-nerved, apiculate or with an awn up to 7.5 mm. long; lower lemma usually 5-nerved, flat, apiculate or with an antrorsely scabrous awn up to 18 mm. long, the palea elliptical, scabrous on the nerves, ca. as long as the lemma, enclosing 3 stamens with orange anthers 1.5-3.6 mm. long (usually longer than those of the upper floret); upper floret 2.5-5.0 mm. long, the coriaceous elliptical lemma tapering into a laterally flattened greenish herbaceous beak up to 1 mm. long; palea similar to the lemma and about as long; lodicules 2, truncate; anthers 3; stigma purple, laterally exserted. Chromosome number $n = 54$ from Costa Rican specimens.

Marshes near the coasts, often in standing water; Limón area, Cahuita, Tarcoles. June to September. Southern coast of the United States, through Mexico and Central America to Argentina; Caribbean Islands.

This is the largest of the Central American species of *Echinochloa* and the most hygrophilous. Large stands are seen in marshes and possibly are grazed by livestock. The form with pubescent nodes and sheaths has been distinguished as var. *spectabilis* (Nees) Martinez, Rev. Arg. Agron. 9:318. 1942, based upon *Echinochloa spectabilis* (Nees) Link. None of our Costa Rican specimens is pubescent.

Echinochloa pyramidalis (Lam.) H. & C., Contr. U.S. Natl. Herb. 18:345. 1917. *Panicum pyramidale* Lam., Tabl. Encycl. 1:171. 1791. *Echinochloa guadeloupensis* (Hack.) Wiegand, Rhodora 23:63. 1921. *Panicum spectabile*, var. *guadeloupense* Hack., Notizbl. Bot. Gart. Berl. 1:328. 1897. Figure 66.

Perennial, with short scaly creeping rhizomes; culms erect or sometimes decumbent and floating in water, up to 2 m. long; usually unbranched except for decumbent portions, lower nodes sometimes producing prop roots, glabrous, up to 1 cm. thick, solid,

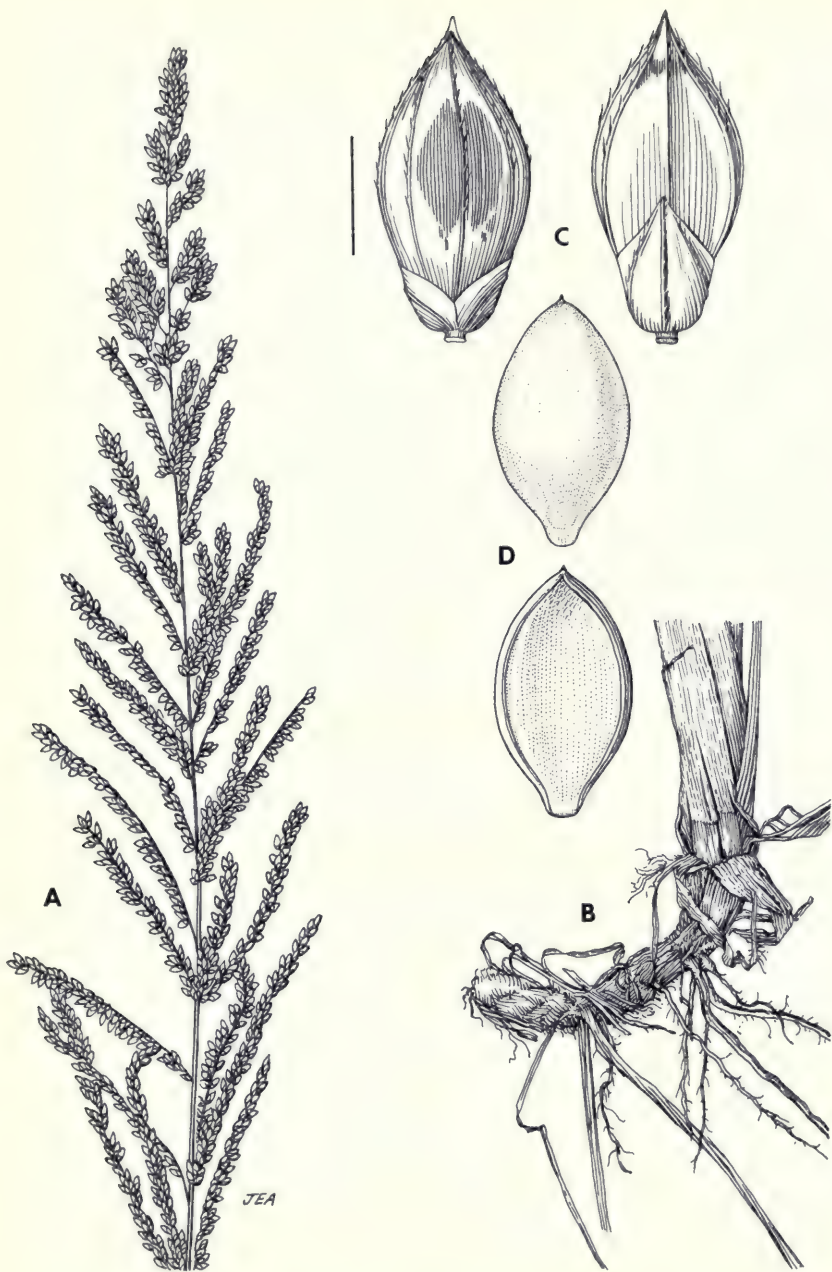


FIG. 66. *Echinochloa pyramidalis*. A, panicle; B, base of culm with rhizome; C, two views of a spikelet; D, two views of a fertile floret.

the lumen filled with aerenchyma containing vascular bundles; nodes glabrous, swollen; sheaths mostly shorter than the internodes, glabrous or papillose-hispid on the back; papillose-hispid on the upper margins below the ligule, somewhat keeled above; ligule a dense row of stiff tan hairs, 1-4 mm. long, those of the lower leaves longer, continued onto the upper sheath margins as a row of papillose-based hairs; leaf blades flat or somewhat keeled and folded near the base, glabrous, with a broad whitish midrib; margins scabrous, length 15-70 cm., width 5-13 mm., apex caudate-acuminate, base rather narrow. Peduncle smooth, cylindrical, exerted up to 30 cm.; inflorescence an open cylindrical panicle, tapering to a narrow apex, 13-45 cm. long, 2-10 cm. wide, with numerous simple lax ascending subverticillate branches up to 10 cm. long, the lower much longer than the upper; rachis angular, scabrous, exposed between the lower branches, bearing tufts of stiff pustulose-based glassy hairs around and below the bases of the branches and scattered single hairs along the primary branches; spikelets subsessile in small clusters on short secondary branches, mostly below the primary branch. Spikelets elliptical 2:1, 2.9-3.5 mm. long, turgid, apiculate, greenish, often with purple blotches; first glume deltoid, apiculate, 1.5-2.2 mm. long, 5-nerved; second glume and lower lemma appressed-hispid on the nerves above the middle, as long as the spikelet; second glume 5-nerved, the nerves equidistant; lower lemma 5-nerved, the lateral nerves in pairs near the margins; lemma containing a palea nearly as long, elliptical, often purple; stamens 3, the anthers yellow, 1.0-1.5 mm. long; fertile floret 2.5-2.7 mm. long; lemma shining, stramineous, faintly 5-nerved; tip greenish, acute; upper margins minutely ciliate; palea flat, equal to the lemma; anthers 3, shorter than those of the lower floret; lodicules small, truncate. Chromosome number $n = 18$ from a Nicaraguan specimen.

This African species is known from Costa Rica only by the following specimen: Guanacaste, Finca La Taboga, 16 January 1969, P. & D. 11661. It also occurs around the Lago de Nicaragua and on the Caribbean Island of Guadeloupe. July and January.

ECHINOLAENA Desvaux

Much-branched decumbent annual; inflorescence a solitary reflexed unilateral spike borne at the tip of a bracted peduncle; spikelets pectinately arranged in 2 rows on the lower side of a flattened rachis, one spikelet terminating the rachis; first glume coriaceous, convex below but flattened toward the tip, many-nerved, much longer than the remainder of the spikelet; second glume boat-shaped, acuminate, ca. two-thirds as long as the first; lower lemma nearly as long as the second glume, herbaceous, 5-nerved, with a prominent membranaceous palea and a staminate flower; upper lemma shorter than the lower one, smooth and shining, coriaceous, cucullate at the apex, the margins thin and exposed near the base, inrolled near the tip; basal callus prominent, truncate, rather fleshy.

Echinolaena is a small genus of a few tropical American and African species. (Panicoideae: Paniceae.)

Echinolaena gracilis Swallen, J. Wash. Acad. Sci. 23:457. 1933. Figure 67.



FIG. 67. *Echinolaena gracilis*. A, blooming plant; B, two views of a spikelet; C, two views of a fertile floret.

Plants trailing, only the tips of the branches ascending; culms rooting at the nodes, hollow, appressed-pilose, often purplish, up to 50 cm. long; prophylla ca. 10 mm. long; nodes bearded; leaf sheaths 1.5-2 cm. long, much shorter than the internodes; strongly papillose-hispid; culms hollow, appressed-pilose, often purplish; ligule an arc of stiff hairs, ca. 0.5 mm. long; blades rather firm, 2-4 cm. long, 5-6 mm. wide, cordate at the base, with conspicuous whitish marginal bands, papillose-hispid on the margins and upper surface at the base, with a few scattered short hispid hairs on the upper surface, glabrous beneath; peduncle short or included in the sheath; spike 1, reflexed, 2-2.5 cm. long, a short stiff bract at the apex of the peduncle; spikelets 7-10.5 mm. long; first glume stiff, coriaceous, linear-triangular, acuminate, prominently ribbed on the outer surface, the upper third somewhat deflected to one side; outer surface prominently pustulose-hispid with spreading hairs; second glume herbaceous, broadly ovate, convex acuminate, 9-nerved, papillose-hispid near the tip, 6-6.5 mm. long; lower lemma herbaceous, ovate, acute, 5-nerved, slightly hispid near the tip, the palea nearly as long as the lemma; flower staminate; second floret shorter than the first, the lemma glabrous, smooth and shining, coriaceous, 3.6-3.7 mm. long, elliptical, faintly 5-nerved, the margins covering the edges of the palea, thin and membranaceous near the base, somewhat inrolled above. Chromosome number $n = 10$ from a Venezuelan specimen.

Known in Costa Rica only by the following specimen: Guanacaste, open *Curatella-Byrsonima* savanna, road to Las Animas, 2 km. E of Carretera Interamericana, elevation 200 m., 4 December 1968, *Pohl & Davidse 11527*. Guatemala and Belize, northwestern Costa Rica; Colombia, Venezuela. Apparently rare.

ELEUSINE Gaertner

Caespitose or somewhat stoloniferous grasses; inflorescence of solitary or usually whorled one-sided spikes; spikelets sessile, densely imbricated in 2 rows along the lower side of a flattened rachis, laterally compressed and keeled, disarticulating above the glumes and between the florets; first glume 1-nerved, the second 5-nerved, both shorter than the lowermost floret; florets several; lemmas awnless, 3-nerved, the lateral nerves close to the midnerve; seed loose in the thin pericarp, strongly ridged.

Eleusine is a small genus of less than 10 species, native to warmer parts of Africa and Asia. Our species is widespread as a weed in warm climates of the entire world. The genus is most closely related to *Dactyloctenium*. Although both genera have unilateral spikes, their spikelets are more similar to those of other genera of the Eragrosteae than to the Chloridoideae. (Chloridoideae: Eragrosteae.)

***Eleusine indica* (L.) Gaertn., Fruct. & Sem. 1:8. 1788. *Cynosurus indicus* L., Sp. Pl. 72. 1753. Figure 68.**

Annual; culms 15-70 cm. long, erect or spreading, branching from the base, rarely from culm nodes; lower nodes often rooting; culms glabrous, hollow, thick-walled; stems leafy, the sheaths mostly overlapping, somewhat keeled, glabrous except for long soft hairs on their upper margins and the throat; ligules 0.5-1.0 mm. long, membranaceous, lacerate; leaf blades 5-30 cm. long, 2-5 mm. wide, mostly folded, glabrous beneath, with



FIG. 68. *Eleusine indica*. Blooming plant, spikelet, floret, seed.

scattered long weak hairs above; peduncle glabrous, solid, pithy, exserted 6-20 cm., with a tuft of conspicuous hairs at the tip; inflorescence of 2-6 spikes, either all in one whorl, or with a solitary spike borne 1-2 cm. below; spikes 1.5-9 cm. long, the rachis flattened, 0.7-1 mm. wide; spikelets 4-5 mm. long; first glume 1.5-2.2 mm. long, 1-nerved, lanceolate as folded; second glume obscurely 5-nerved, 2.2-2.8 mm. long, narrowly ovate as folded, acute; florets 4-7; lemmas 2-3 mm. long, narrowly ovate as folded, glabrous; nerves 3, the lateral ones close to the keel, rarely an extra pair near the margins; keels scabrid; palea slightly shorter than the lemma, the keels salient, scabrid, converging to a boat-shaped tip; anthers 3, 0.2-0.5 mm. long, purplish. Chromosome numbers $n = 9, 18$.

Common; open, disturbed sites; sea level to 1,500 m. elevation. Blooming is most common during the rainy season, but probably occurs to some extent yearlong. Introduced from the Old World; widespread in the Americas from the northern United States to southern South America.

This is a very common weedy grass. Where it is trodden, it tends to form flat circular patches. Local name: *Pata de gallina*. Although most specimens have the nerves of the lemma very close to the keel, two collections from Costa Rica have an extra pair of nerves near the margins.

ELYTrostachys McClure

Tall, hollow-stemmed bamboos; rhizomes pachymorphous; clumps of numerous elongated culms, becoming dependent on trees; internodes cylindrical, thin-walled; initial lateral bud 1 per node, but the primary branch soon rebranching from the base and producing a tuft of numerous slender leafy branches, usually with one larger than the rest; primary culm sheaths with narrow, attenuate, very strongly reflexed blades; auricular bristles elongate, flattened, very conspicuous on new shoots; foliage blades not visibly tessellate. Inflorescences borne on leafy or leafless stems, composed of pseudo-spikelets. These are bracted structures having several orders of branches, each subtended by a broad, short prophyll. The ultimate branchlets, concealed by the outer leafy bracts, are "spikelets" composed of a pair of glumelike bracts with a stiff, flattened rachis (pedicel) produced between them and supporting 1 or 2 perfect florets, the rachilla usually terminating in a rudiment; lemma awnless, grasping the palea only at its base; lodicules 3, flat; stamens 6; stigmas 2. (Bambusoideae.)

Elytrostachys, a newly recognized genus, has only two species, one known only from Venezuela. Vegetatively, the plants can be separated from those of the larger species of *Rhipidocladum* by the strongly reflexed blades of the culm sheaths.

Elytrostachys clavigera McClure, J. Wash. Acad. Sci. 32:176. 1942. Figure 69.

Caespitose bamboo, forming large, open clumps of 30-50 culms, their bases decumbent and trailing, the upper parts clambering and looping up into trees; culms hollow, thin-walled, cylindrical, green, 4-8 cm. thick, glabrous; culm sheaths up to 25 cm. long, more

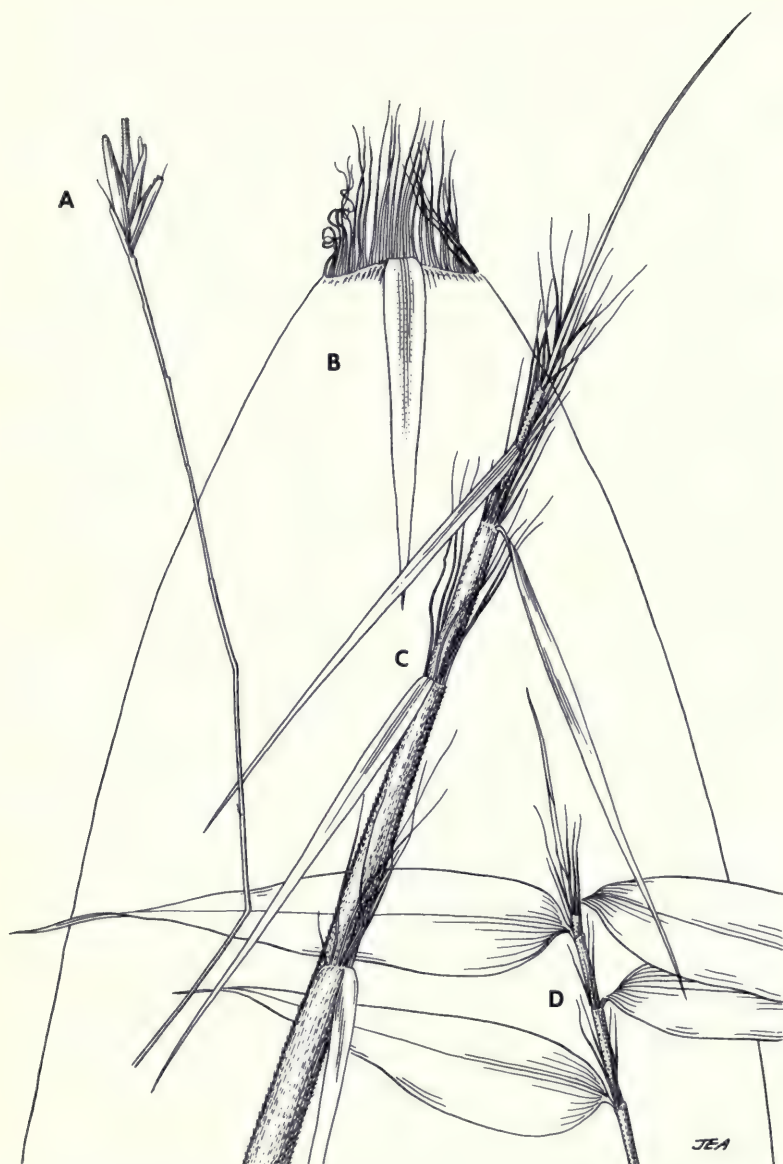


FIG. 69. *Elytrostachys clavigera*. A, pseudospikelet; B, culm sheath showing narrow, strongly reflexed blade and elongated auricular bristles; C, young vegetative culm with reflexed culm blades and prominent auricular bristles; D, branch with foliage blades.

or less appressed-hispid with glassy white hairs; external ligule a stiff membrane, ca. 1 mm. long, minutely ciliate; internal ligule similar; auricular bristles numerous, erect, flattened, dark-colored, 3-5 cm. long; blades much narrower than the sheath apex, strongly reflexed, 4-7 cm. long, less than 1 cm. wide, hispid. Foliage-bearing branches arising from middle and upper nodes, each node bearing a dense fascicle of 10 or more slender branchlets, one (the primary branch) usually larger than the others; branchlets up to 50 cm. long, bearing reduced and early deciduous blades at their basal nodes and several larger blades, 6-18 cm. long and 13-32 mm. wide on their outer portions; blades flat, dark green, 6-18 cm. long, 13-32 mm. wide, ovate 6-7:1, tapering rather abruptly to a caudate apex, glabrous above, more or less hispid beneath; pseudopetiole up to 3 mm. long, puberulent above. Inflorescences numerous, forming false whorls at the nodes of leafy or leafless lateral branches; each inflorescence composed of a pseudospikelet covered with overlapping bracts; ultimate branchlet with a pair of sterile glumelike bracts at its base, a stiff, elongated, flattened puberulent pedicel extended above them, about as long as the bracts and supporting at its apex 1 or 2 florets; glumes none; lemma awnless, up to 17 mm. long; palea as long as the lemma or longer, grooved on the back and clasping a rachilla that is sterile or bears a second floret or a rudiment; flower perfect; lodicules 3, flat, unequal, vasculated; stamens 6, the anthers up to 8 mm. long; stigmas 2; disarticulation below the floret, the old pedicels with cuplike apices protruding from the pseudospikelets.

Forests at low elevations; La Selva, Buenos Aires, Tsâki. The last two specimens, collected in 1891 and 1895, respectively, were in fruit. Our recent collections from La Selva and Buenos Aires were vegetative. The plants may be recognized vegetatively by their large, weak, cylindrical culms, strongly reflexed reduced blades of the culm sheaths, and the conspicuous elongated erect auricular bristles. Venezuela to Honduras.

ERAGROSTIS Wolf

REFERENCES: L. H. Harvey, *Eragrostis* in North and Middle America, Unpubl. Ph.D. Diss. Univ. of Michigan. University Microfilms, Ann Arbor. 269 pp. 1948. S. D. Koch, The *Eragrostis pectinacea-pilosa* complex in North and Central America. (Gramineae-Eragrostoideae), Illinois Biological Monographs 48; I-XI + 74 pp. Univ. of Illinois Press. Urbana. 1974.

Plants annual or perennial, caespitose, stoloniferous, or rarely rhizomatous. Inflorescence an open or contracted panicle; spikelets laterally compressed; florets 2-many; glumes short, keeled, 1-nerved; lemmas ovate, blunt to acute, 3-nerved, the nerves usually prominent; paleas at least half as long as the lemmas, with prominent keels; disarticulation usually sequential from the base upward, the glumes dropping from the rachilla first, followed by the lemmas; paleas usually remaining on the persistent rachilla; anthers 2-3; caryopsis free from the lemma and palea, oblong or elliptical, brown or tan, translucent, usually faintly striate. Some species have spikelets that regularly disarticulate above the glumes and between the florets, and a few species disarticulate in either fashion.

Eragrostis is a large genus, common in warm temperate and tropical climates of the world. The genus contains much diversity, and various segregate genera have been proposed. The awnless spikelets with prominently 3-nerved lemmas and the peculiar type of disarticulation are good marks of recognition. Many of the species are weedy, and only a very few perennial species (e.g., *Eragrostis curvula*) have value for forage. The genus is related to *Triplasis*, *Leptochloa*, *Eleusine*, and *Dactyloctenium* among the Costa Rican grasses. (Chloridoideae: Eragrosteae.)

KEY TO SPECIES OF *Eragrostis*

- 1a. Plants extensively stoloniferous, rooting at nodes, forming flat mats on moist soil *E. hypnoides*
- 1b. Plants caespitose, not stoloniferous; culms usually erect or ascending 2
 - 2a. Keels of paleas prominently ciliate with papillose-based hairs visible from outside of spikelets 3
 - 2b. Keels of paleas not long-ciliate, mostly scabrous 5
- 3a. Panicles densely cylindrical, at least $10 \times$ longer than wide; spikelets subsessile, pedicels much shorter than spikelets; pulvini of branches lacking long hairs *E. ciliaris*
- 3b. Panicles open, rachis visible, length less than $5 \times$ width; pedicels short or long. 4
 - 4a. Panicles open and delicate; pulvini of panicle branches bearing long, silky hairs; plants not viscid *E. tenella*
 - 4b. Panicles rather densely flowered, not delicate; pulvini of branches lacking long hairs; plants usually viscid, particles of soil adhering to sticky areas *E. viscosa*
- 5a. Ligule a membrane *E. glomerata*
- 5b. Ligule a dense row of minute hairs 6
 - 6a. Plants forming large dense clumps with numerous very elongated (to 100 cm.) arching and drooping basal leaf blades that terminate in an elongated thread-like apex; basal sheaths closely overlapping, copiously appressed-hispid; cultivated perennial *E. curvula*
 - 6b. Plants in small tufts, lacking elongated basal leaves; wild plants, annuals or perennials 7
- 7a. Lemmas acuminate, strongly keeled, midnerve projecting as scabrous ridge; length of lemma usually $4-6 \times$ folded width 8
- 7b. Lemmas acute, rounded on the back or slightly keeled but without projecting midrib; length of lemmas less than $4 \times$ folded width 10
 - 8a. Pulvini of panicle branches bearing conspicuous tufts of long hairs 9
 - 8b. Pulvini of panicle branches lacking tufts of long hairs; lemmas 3.4-4.0 mm. long, 3-5-nerved; panicle branches very short, densely covered with overlapping spikelets *E. simpliciflora*
- 9a. Panicle dense, longest branches up to 5 cm. long, bearing spikelets to their bases; spikelets subsessile, overlapping *E. maypurensis*
- 9b. Panicle large and open, the branches up to 9 cm. long, naked near their bases;

spikelets borne on pedicels up to 5 mm. long, not concealing rachis or branches

E. acutiflora

10a. Spikelets linear, 6-9 × longer than wide, deep leaden gray or blackish; glumes minute, the second less than 1 mm. long..... *E. tenuifolia*

10b. Spikelets narrowly ovate or linear, less than 5 × longer than wide, greenish, light gray, stramineous, or purplish; glumes more than 1 mm. long 11

11a. Panicle narrow, dense, 6 or more × longer than wide, branches erect, densely flowered; larger leaf blades up to 60 cm. long; coarse, harsh perennial seashore grasses; Pacific Coast *E. prolifera*

11b. Panicles open, pyramidal, 2-3 × longer than wide; branches spreading; leaf blades usually less than 20 cm. long; small annual grasses of various habitats 12

12a. Mature spikelets 2-3 mm. wide; keels of sheaths often bearing pustulose glands *E. cilianensis*

12b. Mature spikelets 1.5 mm. or less wide; sheaths lacking pustulose glands on keels 13

13a. Spikelets closely appressed to primary branches of panicle *E. pectinacea*

13b. Spikelets at maturity mostly diverging strongly from branches 14

14a. Spikelets slender, delicate, ca. 1 mm. wide; pedicels of lateral spikelets 1-several × as long as spikelets..... *E. pilosa*

14b. Spikelets linear to narrowly ovate, 1.5 mm. or more wide; pedicels of lateral spikelets mostly equal in length to or shorter than spikelets 15

15a. Caryopsis oblong, truncate, with broad, shallow groove on side opposite embryo; spikelets 2-3 × longer than wide, often purplish..... *E. mexicana*

15b. Caryopsis elliptic-oblong, with rounded ends, cylindrical, not grooved; spikelets 3.5-4.5 × longer than wide, green or stramineous *E. tephrosanthos*

***Eragrostis acutiflora* (H.B.K.) Nees, Agrost. Bras. 501. 1829. *Poa acutiflora* H.B.K., Nov. Gen. & Sp. Pl. 1:161. 1816.**

Caespitose perennial, in small, dense tufts; culms erect to ascending, 35-70 cm. long, mostly unbranched; internodes 1.5-2.0 mm. thick, hollow, glabrous; nodes glabrous; sheaths glabrous except at the long-ciliate throat; ligule a minute ciliolate membrane, ca. 0.2 mm. long; leaf blades 6-25 cm. long, 2-4 mm. wide, mostly folded or involute, glabrous beneath, more or less pubescent with scattered long weak hairs on the ridged, scaberulous upper surface. Inflorescence solitary, terminal; panicle ovoid 2:1, 17-28 cm. long, ca. half as wide, open, the branches solitary, the longest one up to 10 cm. long; pulvini silky-ciliate with conspicuous hairs; spikelets more or less appressed along the primary branches; pedicels of lateral spikelets up to 5 mm. long. Spikelets oblong 3-6:1, 5-10 mm. long, with 9-17 florets; the bracts strongly flattened and keeled, usually purple near the keels and whitish near the margins, the spikelets thus appearing bicolored; disarticulation from the base upward, the glumes dropping, followed by the lemmas, the paleas persistent on the flexuous rachilla; the florets rarely disarticulating individually; glumes ovate 4-5:1 as folded, the keels scabrous; first glume 0.9-1.5 mm. long; 1-nerved; second glume similar but wider, 1.3-1.9 mm. long; lower lemmas 2.0-2.2 mm. long, ovate 5:1, the margins nearly straight, surface smooth or scaberulous; palea ca. three-fourths as long as the lemma, the keels bowed-out, short-scabrous; anthers 2, purple, 0.3 mm. long; caryopsis ca. 0.7 mm. long, half as wide, amber. Chromosome number $n = 20$ from a Venezuelan specimen.

Ocean beaches, open roadsides, cultivated fields, savannas, sea level to 450 m. elevation; Guanacaste; General Valley; both coasts. June to December. Southern Mexico to Panama, Brazil, and Bolivia; Trinidad.

Eragrostis cilianensis (All.) Lutati, *Malpighia* 18:386. 1904. *Poa cilianensis* Allioni, *Fl. Ped.* 2:246. 1785. *Eragrostis megastachya* (Koel.) Link, *Hort. Berol.* 1:187. 1827. Figure 70.

Caespitose annual; plants erect, sprawling, or decumbent; culms simple or branched from the lower nodes, the internodes glabrous, up to 2 mm. thick, with a thick wall, the lumen usually filled with pith; nodes glabrous, enlarged; sheaths longer or shorter than the internodes, glabrous except for elongated silky auricular hairs; flat, circular pustulose glands usually present just above the nodes or more commonly on the keel of the sheath; ligule a dense ring of white hairs, ca. 0.5 mm. long; leaf blades 5-20 cm. long, up to 7 mm. wide, glabrous, sometimes bearing pustulose glands on their lower margins. Inflorescences terminal or sometimes axillary, 6-16 cm. long, 2-8.5 cm. wide, ovoid, dense to open, greenish to leaden color, becoming stramineous when dry, with numerous spikelets. Spikelets 6-20 mm. long, linear or ovate, 2-4 mm. wide, with 12-40 florets; disarticulation usually sequential from the base upward, the glumes dropping first, followed by the lemmas, the paleas remaining on the rachilla; occasionally disarticulating between the florets; glumes strongly keeled, scabrous on the keel, the first 1-nerved, 1.2-2.0 mm. long; second similar but broader, sometimes weakly 3-nerved, 1.2-2.6 mm. long; lower lemmas 2.0-2.8 mm. long, ovate, rather blunt, the 3 nerves conspicuous, back sometimes scabrid near the tip; palea ca. 0.6 as long as its lemma, scabrous on the keels, bidentate at the tip; anthers 3, yellow, 0.3-0.5 mm. long; styles 2; caryopsis broadly ellipsoid, 0.6-0.7 mm. long and more than two-thirds as wide, reddish brown.

Rare in Costa Rica; known from Finca la Pacifica, Cañas, Hacienda Tenorio, and Puntarenas. June to October. Pastures and disturbed open ground at low elevations. This introduced European species is very common in warmer parts of the United States, extending southward to northwestern Costa Rica; Cuba and Bermuda; to temperate South America (Argentina).

Like most species of *Eragrostis*, this one has spikelets that first appear with only the basal florets visible and continue to grow and develop more florets at the apex for some time. Because of this, young panicles with juvenile spikelets appear very different from mature ones. The tendency to shed glumes and lower lemmas is not as strong in this species as in some others, and the rachilla occasionally disarticulates. The plants have a fetid odor when fresh, presumably because of the secretions of the pustulose glands. In Central American material, these glands appear to be restricted largely to the keels of the sheaths, whereas in specimens from the temperate zone, they are much more abundant and occur on the sheath bases, panicle branches, and keels of the lemmas.



FIG. 70. *Eragrostis cilianensis*. Blooming plant, young and mature spikelets, segment of rachilla with two florets and a persistent palea.

Eragrostis ciliaris (L.) R. Br. in Tuckey, Narr. Exp. Congo 478. 1818. *Poa ciliaris* L., Syst. Nat. ed. 10. 2:875. 1759. Figure 71.

Caespitose annual in small tufts; culms 3-40 (65) cm. long, erect, ascending, or decumbent, branching from the base or lower nodes; internodes less than 1 mm. thick, hollow, glabrous; nodes glabrous; sheaths glabrous except papillose-pilose on the overlapping margin; auricular hairs abundant, to 4 mm. long, silky; ligule a minute ciliate rim, 0.2-0.5 mm. long. Peduncle exerted up to 11 cm.; panicle solitary, terminal on the main culm or occasionally on leafy branches, 4-14 cm. long, 3-8 mm. thick, densely cylindrical, spikelike, more than $10 \times$ longer than wide; branches mostly less than 1 cm. long, densely flowered to their bases, the lower ones sometimes remote from the main body of the panicle; axils of the branches glabrous; pedicels erect, 0.2-0.6 mm. long, shorter than the spikelets. Spikelets numerous, densely clothing the branches, 2.2-2.5 mm. long, mostly 6-9-flowered, disarticulating above the glumes and between the florets or, rarely, the rachilla remaining intact and the lemmas dropping; first glume 0.8-1.2 mm. long, 1-nerved, ovate, acute; second glume similar, 1.0-1.3 mm. long, the keels sometimes ciliate or scabrous; lower lemmas 1.0-1.3 mm. long, ovate, acute, the internerves scabrid; palea about equal to the lemma, papillose-ciliate on the keels with divergent straight hairs to 0.6 mm. long; anthers 3, purplish, ca. 0.2 mm. long; caryopsis elliptical 2:1, amber, 0.5 mm. long. Chromosome number $n = 10, 20$.

Common on weedy open ground and disturbed soils, from sea level to 1,500 m. elevation; most common at low elevations. Blooming apparently all year. Florida and Gulf Coast of the United States to northern Mexico and southward to Peru and Brazil. Apparently introduced from the tropics of the Old World.

Eragrostis curvula (Schrader.) Nees, Fl. Afr. Austral. 1:397. 1841. *Poa curvula* Schrad., Goett. Anz. Ges. Wiss. 3:2073. 1821.

Long-lived perennial, densely caespitose and forming large circular clumps with very numerous, densely crowded leafy innovations with elongated drooping blades; culms unbranched, up to 150 cm. long, arching, the inflorescence drooping; internodes glabrous, up to 2.5 mm. thick, solid, the lumen filled with pith; nodes glabrous; foliage mostly basal, the basal leaf sheaths densely overlapping, their surfaces covered with flat longitudinal ridges, copiously appressed-hispid with hairs arising in the grooves between the ridges; blades of the basal leaves flat or involute, very elongated, up to 1 m. long, ca. 2 mm. wide, tapering to an elongated caudate tip, the aspect of the clump fountain-like from the numerous drooping and trailing basal leaf blades; ligule a dense fringe of short hairs, ca. 0.5 mm. long; a tuft of elongated silky hairs at the throat and behind the ligule. Peduncle long-exserted, silky-bearded at the apex; panicle solitary, terminal, usually 17-23 cm. long, open, ovoid-cylindrical, the length $3-7 \times$ the width; pulvini silky-bearded; branches mostly paired, naked near the base, the spikelets clustered on short secondary branches and appressed along the primary branches; lateral pedicels usually shorter than the spikelets. Spikelets leaden-gray, 4-7.5 mm. long, usually with 5-9 florets; disarticulation either sequential from the base upward, the glumes falling first, followed by the lemmas, the paleas usually persistent on the intact rachilla; or in some cases, the rachilla disarticulating between the florets; rachilla internodes ciliate at the tip; glumes 1-nerved, the first 1.5-2.1 mm. long, narrowly triangular, the second similar but wider, 2.0-2.5 mm. long; lower lemmas 2.4-3.4 mm. long, oblong-ovate, acute, the nerves not

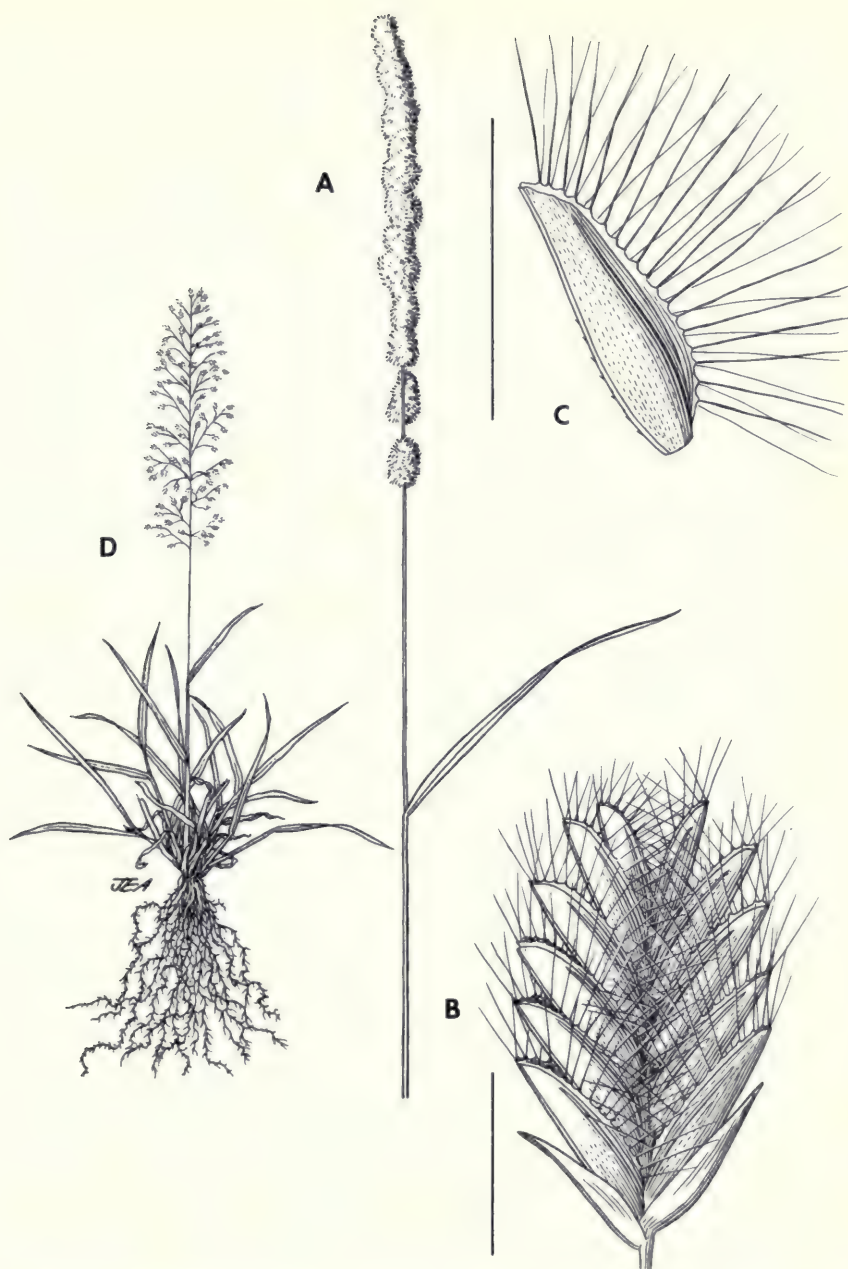


FIG. 71. *Eragrostis* species. *E. ciliaris*: A, panicle; B, spikelet; C, floret showing ciliate palea; *E. tenella*: D, blooming plant.

conspicuous; palea nearly equal to its lemma; anthers 3, purple, 1.1-1.6 mm. long; caryopsis elliptical, amber, 1.4-1.5 mm. long, flattened on the back; embryo dark, ca. half as long as the grain. A wide variety of chromosome numbers has been reported for the group.

This African species has been widely cultivated in the southern half of the United States for forage, stabilization of embankments, and revegetation of abandoned lands. It is also cultivated in temperate South America (Uruguay and Argentina). To a limited extent, it is currently being cultivated as an ornamental in the cities of the Meseta Central. Our only specimen with inflorescences was obtained from the campus of the University of Costa Rica. Several related forms or species occur in Africa and are poorly separable from *E. curvula*. Because of the drooping leaf blades, it has been called "weeping love grass" in English and *Pasto lloron* in Spanish.

Eragrostis glomerata (Walt.) L. H. Dewey, Contr. U.S. Natl. Herb. 2:543. 1894. *Poa glomerata* Walt., Fl. Carol. 80. 1788. *Dian-drochloa glomerata* (Walt.) Burk., Fl. Illus. Entre Rios 168. 1969. Col. Cient. del I.N.T.A. VI, II. Figure 72.

Caespitose annual; culms erect, 25-90 cm. long, branching from the lower and middle nodes; prophylla 3.5-6.0 cm. long, bidentate at the tip; culm internodes 1.5-4.0 mm. thick, glabrous, hard, very thick-walled, with a small lumen that is empty or filled with loose sheets of parenchyma; sheaths glabrous, shorter or longer than the internodes; ligule an erose membrane, 0.4-0.5 mm. long; leaf blades flat, up to 25 cm. long and 7 mm. wide, glabrous or scaberulous above. Peduncle included or exserted; inflorescence a solitary panicle terminal on the main culm or on leafy branches; panicles congested, densely cylindrical, 13-25 cm. long, 2-3 cm. thick; branches fascicled, erect to ascending, densely flowered to their bases; spikelets crowded, overlapping, the pedicels usually much shorter than the spikelets, erect. Spikelets laterally compressed, 2.8-3.4 mm. long, whitish, disarticulating above the glumes and between the florets; glumes ovate, acute, scabrous on the keels, the first 0.7-0.9 mm. long, the second slightly longer than the first; florets usually 8-9; lemmas 1.0-1.1 mm. long, ovate, acute, the nerves conspicuous, green, the internerves whitish or translucent; palea slightly shorter than its lemma, ciliolate at the tip; anthers 2, white, 0.2 mm. long; caryopsis obovoid 3:2, ca. 0.4 mm. long, amber. Chromosome number $n = 10$ from a Costa Rican specimen.

Disturbed open areas, rare in Costa Rica. November and December. The only two specimens known from Costa Rica are from the Cariari Club and La Guacima. Southeastern United States to northwestern South America, southward to Bolivia and Argentina.

Eragrostis hypnoides (Lam.) B.S.P., Prelim. Cat. N.Y. 69. 1888. *Poa hypnoides* Lam., Tabl. Encycl. 1:185. 1791. Figure 73.

Diminutive creeping annual, forming flat circular patches; stolons much-branched, rooting at the nodes; flowering culms fascicled from the rooted nodes, usually ascending, less than 10 cm. long; nodes glabrous; internodes glabrous, less than 0.5 mm. thick,



FIG. 72. *Eragrostis* species. *E. glomerata*: A, panicle; B, group of spikelets; C, leaf base and ligule; *E. prolifera*: D, disarticulating spikelet showing persistent paleas.



FIG. 73. *Eragrostis hypnoides*. Blooming plant, portion of a spikelet showing one floret, persistent paleas, one caryopsis.

hollow; sheaths glabrous except for the finely ciliate overlapping margin; ligule a dense row of minute hairs, ca. 0.5 mm. long; leaf blades 4-30 mm. long, 1.0-1.5 mm. wide, flat or folded, the lower surface glabrous, the upper finely papillose-puberulent. Inflorescences numerous, on short leafy culms arising from the stolons, rather dense, broadly ovoid, 2-4 cm. long and nearly as wide; branches very short, bearing 1-few spikelets; lateral pedicels less than 1 mm. long. Spikelets compressed and keeled, linear, 8-14 mm. long, up to 3 mm. wide, with 15-32 florets; disarticulation sequential from the base upward, the glumes falling first, followed by the lemmas, the paleas remaining on the

intact rachilla; glumes 1-nerved, narrowly ovate, acute, scabrous on the keel, the first 0.6-0.8 mm. long, the second 0.9-1.2 mm. long; lower lemmas narrowly ovate or trullate, 1.8-2.2 mm. long, strongly 3-nerved, glabrous; palea ca. half as long as its lemma; anthers 2, white, ca. 0.2 mm. long; caryopsis elliptical, 0.4-0.5 mm. long and ca. half as wide.

Sand and mud bars along streams, flat wet beach areas around lakes; apparently rare in Costa Rica. None of our collections is recent. Tucurrique, San José. Throughout its range, this species occupies moist, recently exposed shores. Suitable habitats for its establishment may be rare in Costa Rica. Nearly all of the United States, southward through Mexico, Central America to Argentina.

This delicate little creeping grass fruits so abundantly that at maturity, the entire plant consists primarily of the elongated spikelets, which probably carry on the majority of the photosynthesis, since foliage is so sparse.

Eragrostis maypurensis (H.B.K.) Steud., Syn. Pl. Glum. 1:276. 1854. *Poa maypurensis* H.B.K., Nov. Gen. & Sp. 1:161. 1816. Figure 74.

Duration indefinite, probably annual; plants caespitose, erect to prostrate, culms 15-70 cm. long, mostly unbranched or in larger plants with a few branches; internodes 0.5-1.0 mm. thick, hollow, glabrous; nodes glabrous; sheaths about as long as the internodes, varying from nearly glabrous to densely papillose-pilose on the back and collar; auricles usually long-ciliate with hairs to 4 mm. long; ligule a minute stiff fringe of hairs, 0.2-0.3 mm. long; leaf blades 4-15 cm. long, up to 4 mm. wide, densely papillose-pilose to nearly glabrous on the upper surface or both sides. Peduncle exerted up to 15 cm., glabrous to densely papillose-pilose; inflorescence a solitary terminal panicle, 4-20 cm. long, open, narrowly pyramidal, the branches solitary, up to 4.5 cm. long, simple or rebranched; rachis and branches from heavily pilose to nearly glabrous; axils of main panicle branches bearing tufts of long silky hairs; spikelets rather densely clustered and divergent along the branches; pedicels mostly 0.2-0.5 mm. long. Spikelets oblong, strongly keeled and compressed, 7-12 mm. long, ca. 3-4 × longer than broad, glabrous, stramineous to reddish, with up to 27 florets; disarticulation from the base upward, the glumes and then the lemmas dropping, leaving the paleas on the persistent rachilla; glumes 1-nerved, strongly keeled, scabrous on the keel; first glume 1.5-2.5 mm. long, 1-nerved, narrowly triangular, usually acuminate; second glume similar, 1.7-2.5 mm. long; lower florets 1.9-2.7 mm. long, the lemmas ovate 2:1, caudate, the nerves conspicuous, usually green; keel scabrous; palea ca. two-thirds as long, bowed out above the base; the keels scabrous; anthers usually 2, purple, 0.2 mm. long; caryopsis oblong, reddish, ca. 0.5 mm. long. Chromosome number $n = 10$ from Costa Rican and South American specimens.

Dry savannas, pastures, roadsides; common on the savannas of northwestern Guanacaste; dryer western parts of the Meseta Central; Buenos Aires; Boruca. Elevations to 600 m. Baja California and Southern Mexico to Bolivia and Brazil. This species is extremely variable in stature and pubescence.

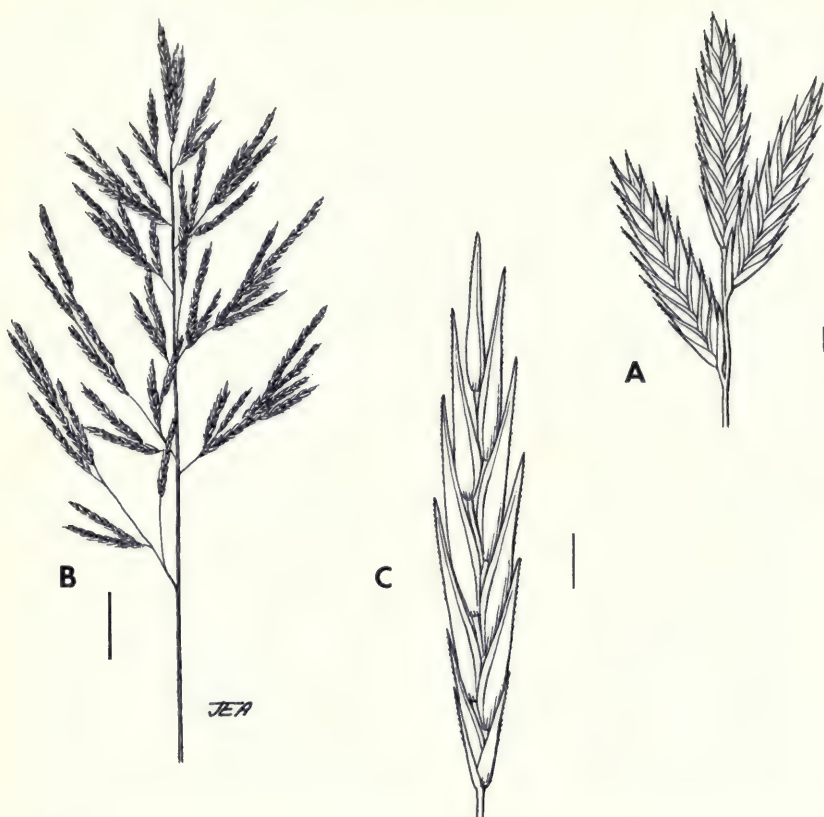


FIG. 74. *Eragrostis* species. *E. maypurensis*: A, group of spikelets; *E. simpliciflora*: B, panicle; C, spikelet.

Eragrostis mexicana (Hornem.) Link, Hort. Berol. 1:190. 1827. *Poa mexicana* Hornem., Hort. Hafn. 2:953. 1815. *Eragrostis limbata* Fourn., Mex. Pl. 2:116. 1881. Figure 75.

Plants caespitose, annual, erect or the lower nodes of the culms geniculate, up to 80 cm. tall but usually much smaller; culms unbranched or branched from the lower nodes, ca. 1 mm. thick; internodes glabrous, hollow or the lumen filled with pith; nodes glabrous, dark; sheaths keeled, mostly shorter than the internodes, glabrous or with a few papillose-based silky hairs on the overlapping margins; auricles and collar densely bearded with elongated silky hairs; ligule a minute membrane, densely ciliate with short white hairs, in total 0.2-0.5 mm. long; leaf blades flat or somewhat involute, 10-25 cm. long, 3-9 mm. wide, smooth beneath, minutely scaberulous above, occasionally with a few delicate elongated hairs on the upper surface near the base. Inflorescences solitary, terminal; panicle open but with numerous spikelets, ovoid, 2-3 × longer than wide, 15-40



FIG. 75. *Eragrostis mexicana*. Portion of a panicle, portion of a spikelet showing a floret and two persistent paleas.

cm. long, the longest branch ca. 12 cm. long; spikelets strongly divergent from the primary or secondary branches, the stiff, flexuous pedicels longer or shorter than the spikelets. Spikelets laterally compressed, 4.5-6.0 mm. long, $2-3 \times$ longer than wide, greenish or purplish; disarticulation sequential from the base upward, the glumes dropping first, followed by the lemmas, the paleas remaining on the intact rachilla; glumes 1-nerved, strongly keeled, scabrous on the keels, the first narrowly ovate, 1.6-1.9 mm. long, acuminate; second glume similar but slightly wider, 1.7-2.2 mm. long; florets usually 6-8; lower lemmas 1.9-2.2 mm. long, ovate 3:1 as folded, the 3 nerves green, conspicuous, tip acute; tip and sometimes the margins scaberulous; palea ca. three-fourths as long as its lemma; anthers 3, purplish, ca. 0.4 mm. long; caryopsis oblong, the ends truncate, 0.6-0.7 mm. long, dark reddish brown, with a longitudinal groove on the side opposite the embryo. Chromosome number $n = 30$ from Costa Rican specimens.

Occasional in coffee and sugarcane plantations, on roadsides and streets, and in gardens. Occasional in the Meseta Central, at elevations of 500 to 1,500 m.; Turrialba; Zarcero. June to February. Arizona and New Mexico to Costa Rica; Venezuela and Brazil.

***Eragrostis pectinacea* (Michx.) Steud., Syn. Pl. Glum. 1:272. 1854.**
Poa pectinacea Michx., Fl. Bor. Amer. 1:69. 1803. Figure 76.

Caespitose annual, 10-60 cm. tall, mostly in small tufts; culms erect to spreading, branching from the base and lower nodes; prophyllum to 3 cm. long; internodes glabrous, either solid, with pith filling the lumen, or partly hollow; nodes glabrous, dark; sheaths mostly shorter than the internodes, glabrous except for a tuft of elongated auricular hairs; ligule a dense line of minute hairs, 0.2-0.5 mm. long; leaf blades 2-15 cm. long, 1.0-4.5 mm. wide, flat or involute, glabrous. Inflorescences solitary, terminal on the main culm or leafy branches; panicles 5-25 cm. long and ca. half as wide; branches solitary or paired, simple or occasionally branched, naked near the base, the spikelets closely appressed to the branches, grayish. Spikelets laterally compressed, linear, 4.5-11 mm. long, with 6-22 florets; disarticulation sequential from the base upward, the glumes dropping first, followed by the lemmas, the paleas remaining on the persistent rachilla; glumes 1-nerved, the first subulate, 0.5-1.1 mm. long, the second narrowly triangular, 1.1-1.7 mm. long; lemmas grayish or with a purplish band near the apex, ovate 4:1 as folded, acute, the nerves evident; palea at least three-fourths as long as its lemma; lower



FIG. 76. *Eragrostis pectinacea*. Blooming plant, partially disarticulated spikelet with persistent lower paleas.

lemmas 1.7-1.9 mm. long; anthers 3, purple, ca. 0.3 mm. long; caryopsis elliptical, 0.7 mm. long, ca. half as wide, amber.

Roadsides, railroad embankments, cultivated fields, disturbed open areas generally; occasional at elevations from sea level to 800 m., both Pacific and Caribbean slopes. June to March. Possibly introduced from the United States. Northern United States to Panama; West Indies; introduced in Argentina.

***Eragrostis pilosa* (L.) Beauv., Ess. Nouv. Agrost. 71, 162, 175. 1812. *Poa pilosa* L., Sp. Pl. 68. 1753.**

Caespitose annual in small tufts; plants 15-45 cm. tall; culms erect, branched from the base and lower nodes; internodes glabrous, hollow, ca. 0.5 mm. thick; nodes glabrous, dark; sheaths glabrous except for a tuft of long, stiff auricular hairs; leaf blades flat or involute, 5-15 cm. long, 2-3 mm. wide, glabrous beneath, scaberulous above. Inflorescences terminal on the main culm or on leafy branches; panicles ovoid 2:1, open and delicate; branches spreading; pedicels strongly divergent, capillary, flexuous, longer than the spikelets. Spikelets grayish, linear, laterally compressed, 2-6 mm. long; disarticulation sequential from the base upward, the glumes dropping first, followed by the lemmas and often the paleas; first glume 0.8-1.0 mm. long, 1-nerved, narrowly ovate, acute, the keel scabrid; second glume similar but wider, 1.2-1.6 mm. long; florets usually 3-8; lemmas 1.2-1.6 mm. long, ovate, rather faintly 3-nerved, sometimes somewhat scabrid toward the tip; palea at least three-fourths as long as its lemma; anthers 3, purple, 0.2-0.3 mm. long; caryopsis elliptical 2:1, brown, ca. 0.7 mm. long.

Known in Central America only by the following specimen: Guanacaste, dry savanna, 21 km. NW of Liberia, 75 m. elevation, *Pohl & Calderón 12167*, 31 July 1966. This introduced European species is widely established in the United States and has previously been reported as far south as southern Mexico. Caribbean Islands.

***Eragrostis prolifera* (Swartz) Steud., Syn. Pl. Glum. 1:278. 1854. *Poa prolifera* Swartz, Nov. Gen. & Sp. Pl. Prod. 27. 1788. *Eragrostis domingensis* (Pers.) Steud., Syn. Pl. Glum. 1:278. 1854. *Poa domingensis* Pers., Syn. Pl. 88. 1805. Figure 72.**

Caespitose perennial, in dense, hard clumps; culms erect or ascending, mostly unbranched, to 2 m. long; internodes glabrous, up to 4 mm. thick, hard, very thick-walled, with a small lumen; nodes glabrous; lower sheaths mostly overlapping; sheaths glabrous; ligule a minute ciliate rim, 0.3-0.5 mm. long; leaf blades harsh, up to 60 cm. long, to 5 mm. wide, flat or involute, glabrous except for the occasional presence of a few long cilia at the throat or at the base of the blade; lower surface glabrous; upper surface minutely scaberulous, apex tapering to an elongate scabrous caudate tip. Inflorescence a solitary terminal panicle; peduncle glabrous, to 40 cm. long; panicle up to 44 cm. long, usually 3 cm. or less thick; branches solitary or fascicled of various lengths together, the longest 9 cm. long, strict, erect, densely flowered to their bases; primary branches bearing numerous erect short secondary branches; spikelets borne on erect pedicels much shorter than the spikelets. Spikelets oblong, stramineous when mature, 4.5-11.5 mm. long, 1.2-2.0 mm. wide; disarticulation sequential from the base upward, the glumes first

dropping, followed by the lemmas, the paleas persistent on the persistent flexuous rachilla; first glume 1.2 mm. long, subulate, 1-nerved, scabrous on the keel; second glume narrowly ovate, 1-nerved, 1.2-1.5 mm. long; florets 8-24; lower lemmas 1.3-1.5 mm. long, ovate, acute, plainly 3-nerved, keeled toward the apex; palea about equal to the lemma; anthers 2, purple, 0.5-0.6 mm. long; caryopsis ovoid, ca. 0.8 mm. long and half as wide, amber, minutely striate.

Salinas and sandy beaches of the Pacific; Puerto Castillo, Puerto Soley, Chomes, Puntarenas. October to January. Southern Mexico to Colombia.

Eragrostis simpliciflora (Presl) Steud., Syn. Pl. Glum. 1:278. 1854.
Megastachya simpliciflora Presl, Rel. Haenk. 1:283. 1830. Figure 74.

Duration indefinite, probably annual; plants caespitose, the culms erect to prostrate, 10-30 cm. long, branching freely from the base and also from the lower and middle nodes; prophylla 9-15 mm. long; internodes 0.7-1.0 mm. thick, hollow, glabrous; sheaths mostly overlapping, glabrous except for auricular hairs up to 4 mm. long, keeled; ligule a row of minute stiff hairs, to 0.1 mm. long; leaf blades up to 15 cm. long, 2-4 mm. wide, more or less involute, the upper surface ridged, scaberulous, bearing scattered elongate weak hairs. Panicles terminal and axillary, mostly 4-8 cm. long, ovoid to narrowly pyramidal, the few branches stiffly spreading or ascending, up to 4 cm. long, bearing few spikelets that are appressed to the branches or divergent. Spikelets purplish or stramineous, linear, 9-24 mm. long, very flattened and keeled, subsessile along the branches, the lateral pedicels 0.2-0.5 mm. long; glumes and lemmas at maturity dropping from the flexuous rachilla, the paleas persistent; rachilla only very tardily disarticulating; first glume ovate, acute, 1-nerved, 1.6-2.0 mm. long; second glume similar, 2.1-2.5 mm. long; florets 12-24; lower lemmas 3.4-3.8 mm. long, ovate 5:1 as folded, acuminate, usually 3-nerved, or with a fainter pair of secondary nerves just inside of the principal lateral nerves; surface minutely scabrid; keel scabrous; paleas ca. two-thirds as long as the lemmas, bowed outward above the base, the scabrous-ciliate keels prominent, the area between the keels deeply infolded; anthers purplish, 0.3 mm. long; caryopsis oval 2:1, 0.8-1.0 mm. long. Chromosome number $n = 20$ from a Costa Rican specimen.

Open dry areas in full sun, roadsides, pastures, savannas; western Meseta Central (Guadalupe, Nuestro Amo, San Pedro de Poás); Hda. Las Animas, Guanacaste. December to March. Southern Mexico to Panama.

Eragrostis tenella (L.) Beauv. ex R. & S., Syst. Veg. 2:576. 1817.
Poa tenella L., Sp. Pl. 69. 1753. *Poa amabilis* L., Sp. Pl. 68. 1753.
Eragrostis amabilis (L.) Wight & Arn. ex Hook. & Arn., Bot. Beechey Voy. 251. 1838. For discussion of the nomenclature of this species, See N. L. Bor, 1960. The Grasses of Burma, Ceylon, India, and Pakistan, pp. 513-514. 1960. Figure 71.

Delicate sprawling caespitose annual in small tufts; culms 5-25 cm. long, branching from the base; internodes glabrous, less than 0.5 mm. thick, hollow or pithy; nodes glabrous; sheaths glabrous except for papillose pilosity on the overlapping margins;

ligule a dense row of minute stiff erect hairs; leaf blades flat, mostly 3-5 cm. long, 2-3 mm. wide, glabrous, scabrous on the margins; collar and auricles beset with straight papillose-based hairs up to 4 mm. long. Peduncle exerted to 4 cm.; inflorescence a solitary, terminal, open cylindrical panicle, 1.5-9 cm. long, up to 3 × longer than wide; rachis bearing silky hairs on the pulvini and scattered flat glandular spots on the internodes; branches spreading; at least some of the pedicels 1-3 × as long as the spikelets. Spikelets whitish or purple, oblong, mostly 1.7-2.0 mm. long, mostly with 4-6 florets; disarticulation above the glumes and between the florets; first glume 0.5-0.6 mm. long, ovate, acute, 1-nerved; second glume similar, 0.7-0.8 mm. long; lemmas mostly 0.8-1.0 mm. long, oblong, usually blunt; nerves conspicuous, the lateral ones submarginal, converging only slightly toward the blunt apex; internerves scabrid; palea nearly as long as its lemma, the keels prominently ciliate with strongly divergent papillose-based straight hairs up to 0.3 mm. long, these conspicuous on the spikelets; anthers 3, purplish, 0.2 mm. long; caryopsis elliptic 2:1, clear reddish amber colored, 0.5 mm. long.

Casual weed in open areas, mostly near the Caribbean; Limón, Limón airport; Isla Uvita; Puerto Viejo (S of Cahuita); Turrialba. June to September. Introduced from the Old World. Southeastern United States to Texas; west coast of Mexico; Central America to Panama and tropical South America; West Indies.

Eragrostis tenuifolia (A. Rich.) Hochst. ex Steud., Syn. Pl. Glum. 1:268. 1854. *Poa tenuifolia* A. Rich., Tent. Fl. Abyss. 2:425. 1851. Figure 77.

Caespitose perennial; clumps dense, hard; culms 30-75 cm. long, erect to prostrate, unbranched or branched from the lower nodes; internodes hollow, glabrous; nodes glabrous; prophylla up to 2.5 cm. long; sheaths about as long as the lower internodes, strongly compressed and keeled, glabrous, the overlapping margin softly pilose; throat pilose with hairs to 2 mm. long; ligule a dense line of minute hairs, to 0.25 mm. long; leaf blades flat or folded, up to 20 cm. long, 2-3 mm. wide. Peduncle exerted up to 18 cm., glabrous; inflorescence a solitary terminal panicle, 5-19 cm. long, narrowly pyramidal, very open; rachis angular, grooved, scabrous on the angles, the pulvini prominent, strongly ciliate with fine silky hairs to 2 mm. long; branches solitary, strongly divergent, thin and stiff; pedicels strongly divergent from the branches, the lateral ones 3-13 mm. long, the terminal ones longer. Spikelets linear, leaden-colored, 6-14 mm. long, 1.5-2.0 mm. wide, laterally compressed but not strongly keeled; disarticulation sequential from the base upward, the glumes dropping first, followed by the lemmas, the paleas remaining on the flexuous persistent rachilla; glumes much reduced, subulate, the first 0.3-0.6 mm. long, separated from the second by a visible internode; second glume similar, 0.5-1.0 mm. long; florets 6-15; lemmas ovate 4:1 as folded, acute, faintly nerved; palea more than three-fourths as long as the lemma, bowed out above the base; anthers 3, whitish, 0.4-0.5 mm. long; flowers apparently cleistogamous, the anthers remaining tangled with the style branches and not exerted; caryopsis oblong, 0.6-1.0 mm. long, blunt, amber, about half as wide as long. Chromosome number $n = 20$ from a Costa Rican specimen.

Soccer fields, roadsides, streets, disturbed open areas generally; very common in the Meseta Central, but now known from La Cruz on

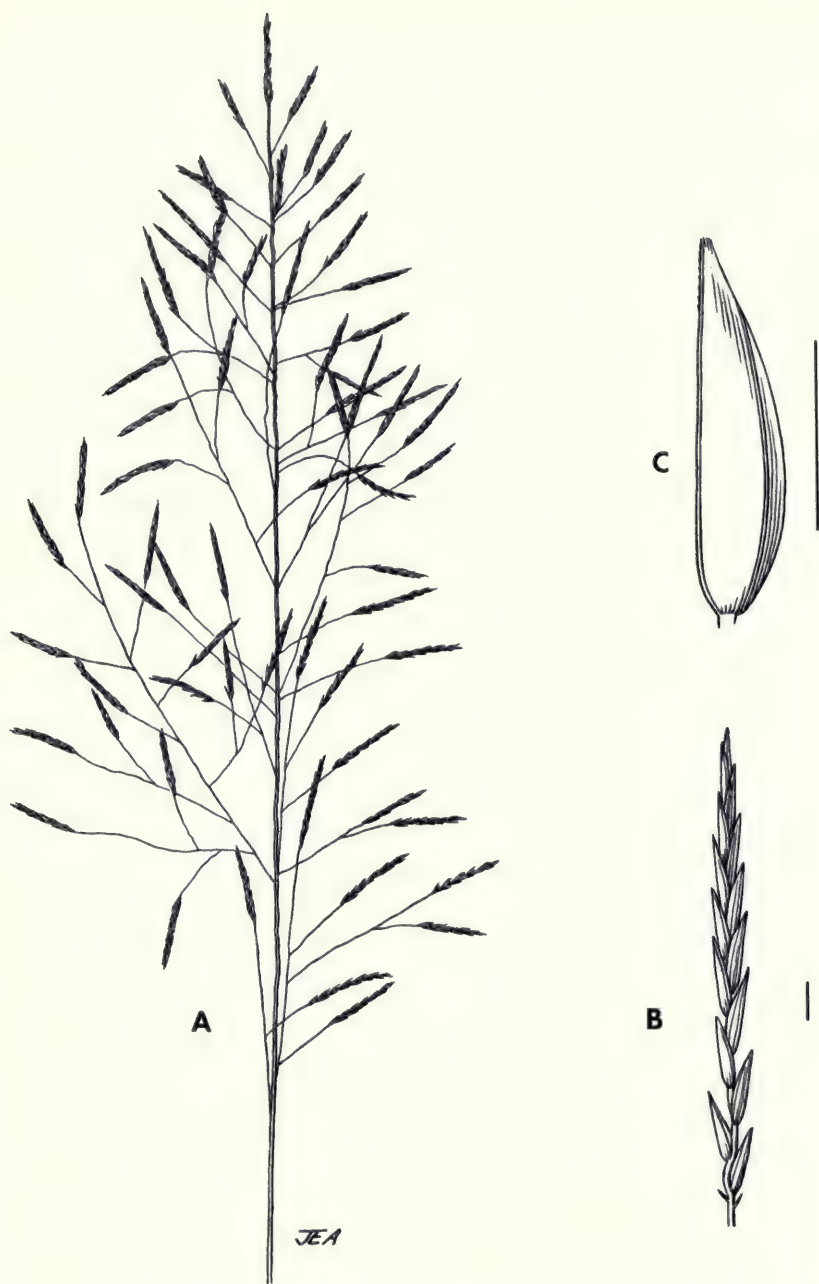


FIG. 77. *Eragrostis tenuifolia*. A, panicle; B, spikelet; C, floret.

the Nicaraguan border to San Vito and Agua Buena on the Panamanian frontier. Introduced from Africa or India. This species is apparently of recent introduction and is spreading rapidly. It is as yet little known from the Caribbean slope (Juan Viñas, La Tirimbina). The plants form a wiry, tough turf that virtually excludes other species on areas such as playing fields, where they are trampled extensively. Not previously recorded from the western hemisphere.

Eragrostis tephrosanthos Schultes, Mant. 2:316. 1824. *Eragrostis arida* Hitchc., J. Wash. Acad. Sci. 23:449. 1933.

Caespitose annual in small tufts; plants erect, 15-90 cm. tall; culms branched from the base or lower nodes; internodes glabrous, hollow; nodes glabrous, dark; leaf sheaths glabrous except for a tuft of elongated auricular hairs; ligule a dense row of short white hairs, 0.5-0.7 mm. long; leaf blades flat or involute, 3-21 cm. long, 1-5 mm. wide, glabrous. Inflorescences solitary, terminal on the main culm or leafy branches; panicle open, pyramidal, 4-25 cm. long, 2-18 cm. wide, about twice as long as wide; branches mostly solitary or paired, strongly divergent from the rachis, the largest ones secondarily branched; pulvini and branch axils with tufts of elongated hairs; pedicels strongly divergent from the branches, stiff and flexuous, often longer than the spikelets. Spikelets linear-ovate, 4-10.5 mm. long, 1.2-1.5 mm. wide, with 7-20 florets; disarticulation sequential from the base upward, the glumes dropping first, followed by the lemmas, the paleas remaining on the intact rachilla; glumes 1-nerved, scabrous on the keel, the first 0.5-1.4 mm. long, narrowly ovate, acute, the second 0.9-1.7 mm. long, ovate, acute; lower lemmas 1.1-2.1 mm. long, ovate, acute, the nerves evident; keel scabrid; surface slightly scabrid near the tip; paleas at least three-fourths as long as their lemmas; anthers 3, purplish, 0.2-0.3 mm. long; caryopsis elliptic-oblong, 0.6-0.7 mm. long, more than half as wide, reddish brown, minutely striate.

Occasional; fields, roadsides, railroad embankments; elevations from sea level to 600 m. Southern General Valley; Piedras Blancas; San José; La Garita; Turrialba. March to October. Florida and southwestern United States to Panama; West Indies; in South America to Brazil.

This species is very similar to *E. pectinacea* in most respects, differing chiefly in the spreading pedicels of the spikelets. Koch states that he has not observed hybrids between the two. Some immature specimens are difficult to identify definitely.

Eragrostis viscosa (Retz.) Trin., Mém. Acad. Imp. Sci. St. Pétersbourg Hist. Acad. 1:397. 1830. *Poa viscosa* Retz., Obs. Bot. 4:20. 1786.

Caespitose annual; culms numerous, ascending to erect, branching from the lower and middle nodes, 20-50 cm. tall; internodes less than 1 mm. thick, hollow, thick-walled, glabrous; nodes glabrous; prophylla 2.0-2.5 cm. long; sheaths more or less keeled above, shorter than the internodes, more or less viscid, the overlapping margins and auricles papillose-pilose with hairs up to 4 mm. long; ligule a dense row of stiff hairs, ca. 0.5 mm. long; leaf blades 5-13 cm. long, up to 4 mm. wide, bearing scattered weak papillose-based

hairs on the upper surface; stems and leaves often viscid and coated with adherent soil particles. Inflorescence terminal on the main culm or on leafy branches; panicle open cylindrical, 11-13 cm. long, ca. 2 cm. wide; lower panicle branches solitary and remote, the upper more or less whorled; axils lacking tufts of elongated hairs; spikelets rather densely arranged on the short lateral branches, the pedicels of lateral spikelets shorter than the spikelets. Spikelets ovate, 3.0-5.5 mm. long, disarticulating above the glumes and between the florets; first glume ovate, acute, 0.8-1.4 mm. long, 1-nerved; second glume similar, 1.0-1.5 mm. long; florets 6-12; lower lemmas 1.1-1.8 mm. long, ovate, rather blunt, the lateral nerves submarginal, the internerves scabrid; palea about equal to the lemma, the keels ciliate with divergent papillose-based hairs to 0.6 mm. long; anthers 3, purple, 0.2-0.3 mm. long. Caryopsis elliptical, 2:1, ca. 0.5 mm. long, reddish brown.

Bluffs, Playas del Coco; disturbed pasture 20 km. N of Liberia on the CIA. August to November. Southern Baja California to the Yucatan and southward to Panama. Introduced from southeastern Asia.

***Eragrostis ekmanii* Hitchc., Man. Gr. W. Ind. 43. 1936.**

A specimen of this species in US bears a label indicating that it was collected in Costa Rica (*O. Jimenez 713*, San Francisco de Guadalupe, Jan. 1913). The identification is correct, but the geographic data is extremely suspect. The type, which is the only other specimen known, was collected on the Isle of Pines, Cuba.

EREMOCHLOA Büse

Stoloniferous and rhizomatous perennial; inflorescences are slender terminal or axillary dorsiventral rames, the sessile awnless fertile spikelets all on one side of the rachis, each overlapping the base of the one above, each accompanied by a flattened leathery pedicel, bearing at its apex a minute rudimentary spikelet. First glume of sessile spikelet oblong, barbed along the lower margins, dorsally flattened, many-nerved, bearing a papery apical wing, notched at the midrib, and two narrow flanges on the inner side which clasp the margins of the slightly keeled dorsally flattened second glume; florets 2, the lower staminate, with membranaceous nerveless lemma and palea, the upper similar but perfect-flowered; lodicules 2, fleshy, forked at the apex.

A small genus of ca. 10 species, native from eastern Asia to Australia. The following species is sometimes cultivated in warm climates. (Panicoideae: Andropogoneae.)

***Eremochloa ophiuroides* (Munro) Hack., in DC., Monogr. Phan. 6:261. 1889. *Ischaemum ophiuroides* Munro, Proc. Amer. Acad. Arts 4:363. 1860. *Sehima ciliare* (L.) G. Rob., subvar. *ophiuroides* (Munro) G. Rob., Monogr. Androp. 318. 1960. Figure 78.**

Plants extensively stoloniferous, the stolons with short internodes and numerous short erect flowering branches; rhizomes also produced; erect flowering culms 10-20 cm.

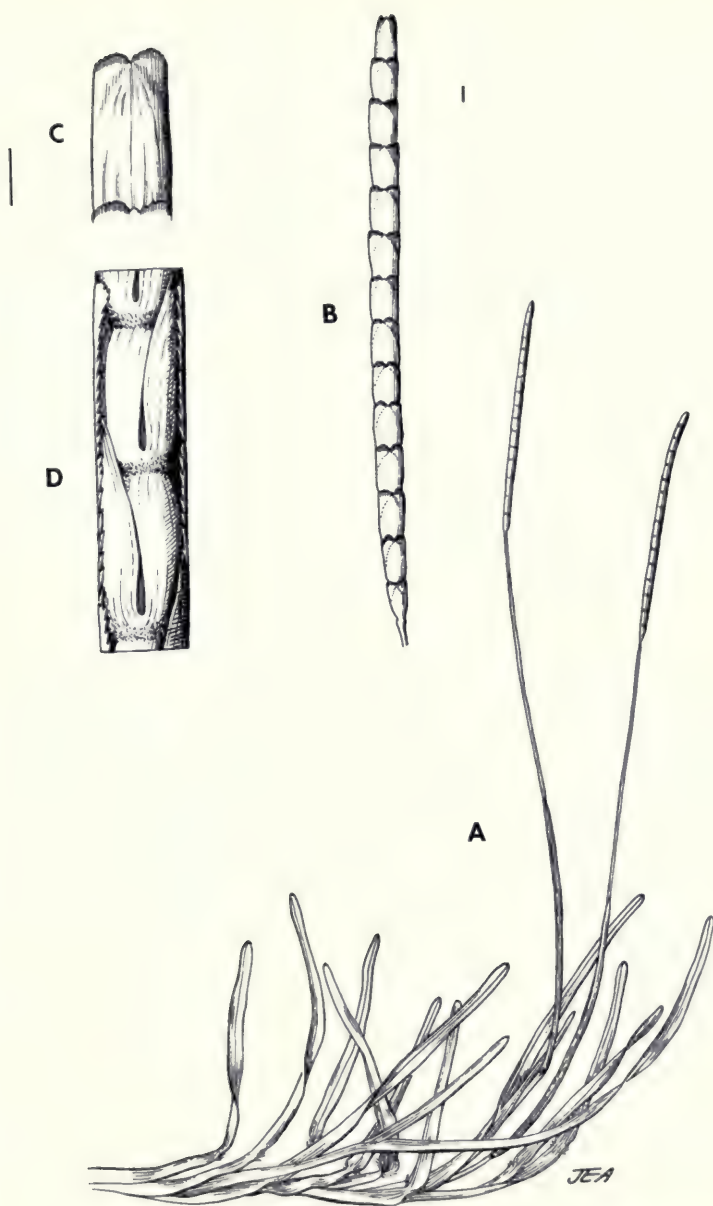


FIG. 78. *Eremochloa ophiuroides*. A, blooming plant; B, rame; C, a sessile spikelet; D, portion of a rame, showing two flattened pedicels with rudimentary spikelets at their tips.

tall, ca. 1 mm. thick, hollow, glabrous; nodes dark, with a short ciliate fringe at the base; leaves 2-3 per culm, the uppermost with a short or rudimentary blade; sheaths mostly overlapping, strongly keeled; ligule a short ciliate membrane, 0.5-1.0 mm. long; blades short, linear, 3-5 (8) cm. long, abruptly rounded to a scabrid tip, contracted into a short pseudopetiole at the rounded, ciliate base. Peduncles slender, 1-5 cm. long, terminal and axillary. Inflorescence a stiff slender rame, 3-5 cm. long, ca. 2 mm. thick, the overlapping first glumes of the fertile spikelets all on one side of the rachis, the rachis joints and pedicels of the abortive pedicellate spikelets on the other. Rachis flattened, tough, scarcely disarticulating. Spikelets paired, the sessile ones 3.2-4.0 mm. long, 1.5-2.0 mm. wide, often purplish near the apex; second glume equal in length to the first, but narrower, elliptical, acute, not winged, 3-nerved; florets 2, the lower staminate, the upper perfect-flowered; lemma of lower floret 2.5-3.0 mm. long, ovate, acute, nerveless; palea about equal; upper lemma 2.5-2.8 mm. long, similar to the first, its palea about equal to the lemma; anthers 3, 1.7-2.0 mm. long, purple. Chromosome number $n = 9$.

This Asiatic species is often cultivated as a lawn grass in warm moist climates and is fairly common in the southeastern United States. Our only collection from Costa Rica is from Finca Las Cruces near San Vito de Java, where it makes up a lawn. It makes a strong, erosion-resisting turf, but the numerous, wiry inflorescences may be objectionable. It also occurs at El Zamarano, Honduras. Blooming time in Central America is in June and July.

ERIOCHLOA Humboldt, Bonpland & Kunth

Annual or perennial caespitose or stoloniferous grasses; inflorescence of 1-many spikelike racemes borne on a common rachis; spikelets solitary or paired, subsessile or short-pedicellate, borne along the lower side of the rachis. Spikelets disarticulating below the glumes, dorsally compressed, ovate, acute; the thickened basal rachilla joint and first glume united to form a protruding knoblike structure at the base of the spikelet; first glume abortive or reduced to a minute cufflike scale embracing the rachilla joint; second glume and sterile lemma subequal, completely covering and concealing the shorter fertile floret; fertile lemma cartilaginous, minutely rugose-striate, the margins not inrolled, covering the edges of the flat palea of similar texture; tip of the lemma minutely bristly or prolonged into a minute awn.

About 25 species in warm climates of both eastern and western hemispheres. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Eriochloa*

- 1a. Inflorescence of 1-3 simple racemes, each 1-2 cm. long *E. distachya*
- 1b. Inflorescence of numerous usually branched primary branches, the longer ones 5-8 cm. long *E. polystachya*

Eriochloa distachya H.B.K., Nov. Gen. & Sp. 1:95, Tab. 30. 1816.
Helopus brachystachys Trin., Sp. Gram. Icon. & Descr. II, Tab. 277.
 1829. Figure 79.

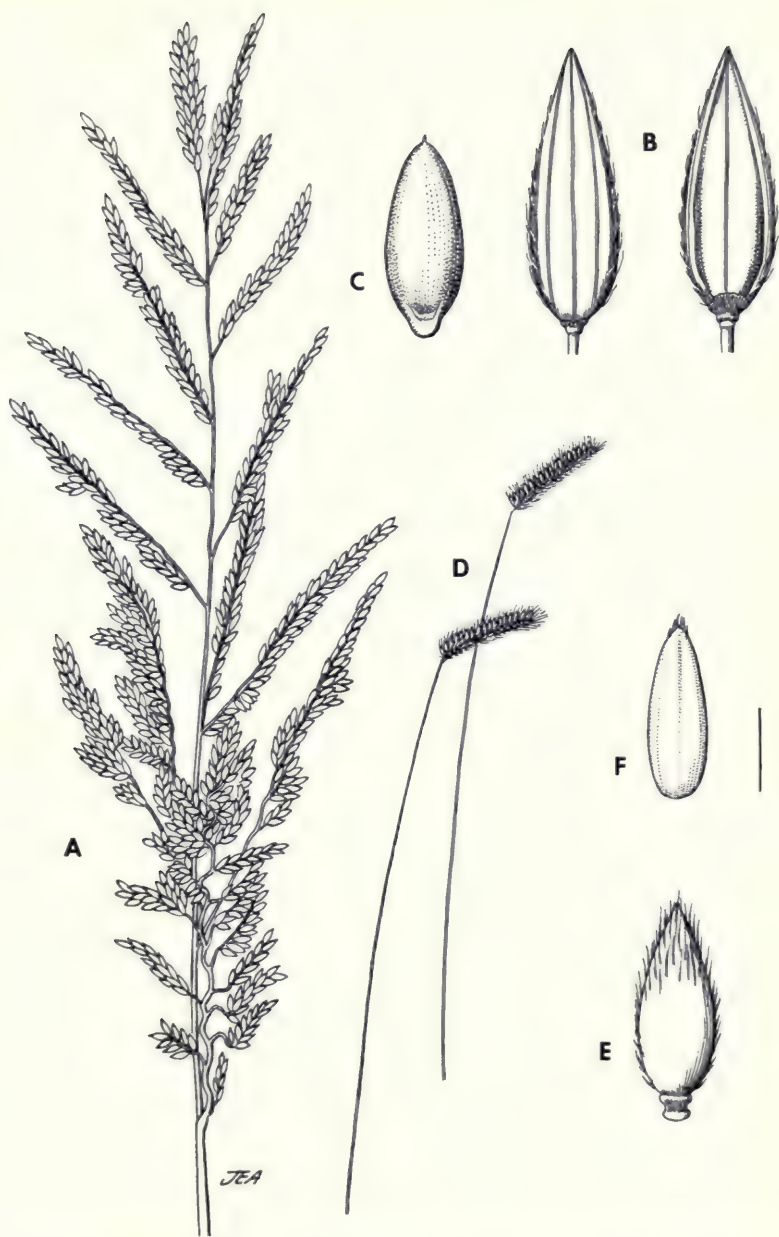


FIG. 79. *Eriochloa* species. *E. polystachya*: A, panicle; B, two views of a spikelet; C, fertile floret; *E. distachya*: D, inflorescences; E, spikelet; F, fertile floret.

Caespitose annual; plants 25-50 cm. tall, erect, or the culm bases decumbent; branching freely from the base and the culm nodes; prophylla 2-3 cm. long; culms 1 mm. thick, hollow, glabrous; nodes bearded with ascending or retrorse hairs; leaf sheaths glabrous or villous on the back and margins; ligule a minute fringe of white hairs, 0.4-0.5 mm. long; leaf blades flat, 2-13 cm. long, 2-6 mm. wide, mostly glabrous, the uppermost sometimes reduced. Peduncle slender, 5-12 cm. long, glabrous near the base, increasingly villous toward the apex; inflorescence of 1-2 silky racemes, these 1-2 cm. long, usually arched, 1-sided, the spikelets alternating in 2 rows along the lower side of the densely silky-villous rachis; pedicels minute, villous, with a ring of longer hairs near their apex; spikelets placed with the sterile lemma facing toward the midline of the rachis and the backs of fertile lemmas facing outward. Spikelets elliptic-ovate, 2.5-3.5 mm. long, acute, dorsally compressed, with a protruding basal knob ca. 0.3 mm. long and 0.5 mm. wide formed of the thickened basal rachilla joint surrounded by an abortive cuplike first glume; surface of disarticulation umbrella-shaped, smooth and shiny; second glume and sterile lemma equal, similar, 2.3-3.1 mm. long, completely covering the fertile floret; the glume 5-nerved, the lemma 3-nerved, both bearing stiff erect to spreading hairs, those toward the apex much longer than the rest; fertile lemma stiff, minutely rugulose, elliptical, 1.9-2.3 mm. long, faintly 3-nerved, bearing a few minute spicules at the tip, the flat margins barely covering the edges of a flat palea of similar texture; anthers 3, tan, 1.2-1.5 mm. long; caryopsis elliptic-oblong, 1.5 mm. long, white, opaque. Chromosome number $n = 9$ from a Costa Rican specimen.

Rare; savannas of Boruca and Buenos Aires. December. Guatemala and Costa Rica to Panama, Brazil and Paraguay.

Eriochloa polystachya H.B.K., Nov. Gen. & Sp. 1:95. Tab. 31. 1816. Figure 79.

Duration indefinite but probably perennial; culm bases long-decumbent and rooting at the nodes; upper parts of culms ascending, 1-2 m. long, branching freely, glabrous, hollow, thin-walled, 3-4 mm. thick; nodes conspicuously bearded with spreading or retrorse hairs; sheaths more or less papillose-hispid; ligule a minute stiff membrane, crowned with a longer dense row of silky white hairs, totaling 0.8-1.2 mm. long; collar of the sheath and base of the upper blade surface minutely velvety; blades glabrous or sparsely papillose-hairy, 10-25 cm. long, 8-15 mm. wide. Peduncles exerted up to 12 cm., glabrous except for the heavily bearded apex; inflorescences terminal on leafy culms; panicles narrowly ellipsoidal, 15-25 cm. long, 2-3 × longer than wide; rachis and branches more or less papillose-hirsute; branches straight, ascending, usually re-branched, the spikelets racemose, solitary or paired along the undersides of the primary or secondary branches; members of a pair unequally short-pedicellate; backs of the fertile lemmas placed away from the rachis. Spikelets narrowly ovate, 2.5:1, acute, 3.2-3.6 mm. long with a small protruding basal knob; first glume 0.2 mm. long, truncate, cufflike, usually purple; second glume and sterile lemma equal, sparsely appressed-hairy, 3.0-3.5 mm. long, ovate, acute; the second glume 5-nerved; sterile lemma with 3 strong nerves and 2 weak marginal ones; fertile floret 2.2-2.5 mm. long, noticeably shorter than the glume and sterile lemma, elliptical, faintly 3-nerved, with a minute apical awn ca. 0.1 mm. long; lemma and palea white, stiff, faintly striate, the margins of the lemma flat, covering the edges of the palea; anthers 3, greenish, 1.0-1.5 mm. long; stigmas purple. Chromosome number $n = 18$ from Costa Rican specimens.

Cultivated as a forage crop and commonly escaped to roadsides and margins of ponds; elevations up to 1,200 m.; most common in humid areas. March to September. West Indies and northern South America. Not previously reported as a wild plant in Central America. Common name in Costa Rica is *Janeiro*. The plants are very similar to *Brachiaria mutica* ("Para grass").

ERIOCHRYSIS Beauvois

REFERENCE: J. R. Swallen, Notes on grasses: *Eriochrysis*, Phytologia 14:88-91. 1966.

Caespitose erect perennial; inflorescence a dense silky cylindrical intricately branched panicle of short rames; spikelets awnless, paired at each node of the rachis, one sessile and the other short-pedicellate; disarticulation at the bases of the sessile spikelets, the 2 spikelets of the pair falling together or the pedicellate one dropping from the pedicel. Glumes, rachis internodes, and pedicels all densely brown-silky. Spikelets of each pair similar, but the pedicellate one slightly smaller; glumes equal, chartaceous, completely covering and concealing the inner spikelet parts; outline of spikelet narrowly ovate, acute; first glume flat on the back, with inflexed margins which cover the edges of the keeled second glume; callus, margins, and tip of the first glume and the keel and tip of the second glume fringed with long, silky, golden-brown hairs. Sterile lemma and fertile lemma thin, nerveless, slightly shorter than the glumes; no paleas present; lodicules thick and fleshy, truncate. Sessile spikelet with a perfect flower; pedicellate spikelet with a pistillate flower only.

Species about 10, from tropical America, Africa, and Asia.

Eriochrysis cayanensis Beauv., Ess. Nouv. Agrost. 8. Pl. 4, f. 11. 1812. *Saccharum cayennense* (Beauv.) Benth., J. Linn. Soc. Bot. 19:66. 1881. *S. cayennense* Benth., Roberty, Mon. Syst. Androp., Boissiera 9:360. 1960. Figure 80.

Perennial, in small, dense clumps from a deep-seated base; plants 90-300 cm. tall; basal leaves numerous, their blades very elongate, up to 50 cm. long and 6 mm. wide, often folded; bases of culms clothed with the fibrous remains of the old sheaths; culms erect, 2-4 mm. thick, hollow, glabrous; nodes densely bearded with straight ascending hairs; foliage as a whole copiously velvety-pubescent; sheaths densely hairy on the collar; ligule a short ciliate membrane, 1-2 mm. long; blades of culm leaves shorter and wider than the basal ones, up to 12 mm. wide; uppermost blade much reduced; inflorescence included at the base or the peduncle exerted up to 15 cm. Inflorescence dense, cylindrical, lobulate, lustrous golden-brown, the densely clustered spikelets mostly concealed by the long silky pubescence of spikelets, rachis internodes and pedicels; length 12-18 cm., width 1-3 cm.; branches short, ascending, concealed by the spikelets and hairs. Pedicels and rachis joints silky-pubescent, very short, 1.0-1.3 mm. long. Spikelets paired, or the terminal segment of a rame bearing a sessile spikelet and 2 pedicellate ones. Spikelets 2.0-4.4 mm. long, the pedicellate member of the pair usually shorter than the sessile one; glumes



FIG. 80. *Eriochrysis cayanaensis*. Blooming plant.

subequal and the full length of the spikelet, concealing the inner parts; lower floret sterile, represented by an empty lemma slightly shorter than the first glume; upper floret with a keeled lemma ca. as long as the second glume but no palea; flower of sessile spikelet perfect, that of the pedicellate spikelet pistillate; lodicules 2, large and fleshy, truncate; anthers 3, yellow, 1.3-1.7 mm. long. Chromosome number $n = 10$ from Costa Rican specimens.

Open marshy places, from near sea level to 1,400 m. July to October. Uncommon in Costa Rica; known from General Viejo and Cañas Gordas. Mexico to Bolivia and Argentina.

This is one of the most striking of the tropical American grasses, easily recognized by its beautiful brown inflorescence, somewhat resembling a small cattail. The specific epithet was spelled *cayanensis* by Beauvois in two separate places in his work. Later authors have usually spelled it *cayennensis*, referring to Cayenne. Beauvois, however, makes no such reference.

EUCLASTA Franchet

Inflorescences terminal on the main culm or on leafy lateral branches. Peduncle very slender, flexuous; rames several, slender, borne racemously along a slender central rachis, each rame on a filiform naked flexuous branch. Spikelets dorsally compressed, the basal 1-several pairs sterile, the members of the pair alike and awnless; rachis between sterile pairs not disarticulating, the sessile spikelets remaining on the rachis after the upper parts of the rame have disarticulated; pedicellate spikelets of basal pairs disarticulating; upper spikelet pairs of the rame dimorphic, the sessile perfect-flowered spikelet bearing an exerted twisted and geniculate awn, the pedicellate one awnless, sterile. Disarticulation at the apex of each internode of the rachis, the paired spikelets falling together or the pedicellate spikelet deciduous; rachis segments and pedicels flat, ciliate, with a very thin, translucent band down the length of the center; terminal rachis segment bearing 1 sessile spikelet and 2 pedicellate ones; glumes membranaceous, the first flat on the back, many-nerved, ciliate and slightly keeled on the margins of the upper half, the lower margins incurved; second glume shorter than the first, boat-shaped, 3-nerved; sessile spikelets usually with a thin, nerveless lower lemma lacking palea or flower; upper fertile lemma reduced to the flattened whitish base of the awn; lodicules 2, truncate; anthers 3, linear.

The genus *Euclasta* consists of a single species, distributed in the tropics of Africa and America. It is related to *Andropogon*, *Hyparrhenia*, and *Bothriochloa*, being closest to the last in the possession of rachis segments and pedicels with thin translucent centers. The persistent basal portion of the rames, bearing persistent sessile spikelets, along with the delicately peduncled rames, are characteristic of *Euclasta*. The spikelets are much softer than is usual in this tribe. (Panicoideae: Andropogoneae.)

Euclasta condylotricha (Hochst.) Stapf, Fl. Trop. Africa 9:181.

1917. *Andropogon condylotrichus* Hochst. in Steud., Syn. Pl. Gram. 377. 1855. *Amphilophis piptatherus* (Hack.) Nash, N. Amer. Fl. 17:127. 1912. Figure 81.

Weak sprawling annual, the decumbent stems rooting at the lower nodes, branching freely from the lower nodes; internodes glabrous, pithy; nodes bearded; sheaths longer or shorter than the internodes, glabrous except pilose on the collar; ligule a firm brownish membrane, ca. 1 mm. long, ciliate with white hairs longer than the membranaceous part; leaf blades flat, 7-20 cm. long, 3-8 mm. wide, hirsute beneath, usually glabrous above, usually with a few long, pustulose-based hairs on the basal margins. Peduncles very slender, terminal or axillary from the upper culm nodes, heavily bearded at the apex and on the rachis nodes. Rames usually 2-6, solitary or paired at the rachis nodes, 2-4 cm. long, forming a fan-shaped cluster. Basal spikelet pairs: spikelets about equal, 4.6-6.0 mm. long, sterile; ovate 3:1, first glume 5-7-nerved, narrowly truncate at the apex; second glume shorter, boat-shaped, 3-nerved; basal portions of the glumes bearing stiff spreading hairs. Upper spikelet pairs: sessile spikelets 3.5-3.8 mm. long, the first glume 5-7-nerved, flat on the back, bristly hirsute on the lower half, slightly truncate at the apex; second glume ca. 3.5 mm. long, 3-nerved; sterile lemma thin and nerveless, ca. half as long as the spikelet; upper lemma reduced to the brown, twisted and geniculate awn, 3-4 cm. long; anthers 1.0-1.2 mm. long. Chromosome number $n = 10$ from a Venezuelan specimen.

Tuff outcrops in savanna and rocky sea cliffs, sea level to 300 m., Hacienda Murcielago. October to December. Mexico to Venezuela and Brazil; West Indies; tropical Africa.

EUSTACHYS Desvaux

REFERENCE: G. V. Nash, A revision of the genera *Chloris* and *Eustachys* in North America, Bull. Torrey Bot. Club 25:432-450. 1898.

Caespitose perennial grasses, often with short stolons; foliage glabrous; leaves mostly aggregated near the bases of the culms, the sheaths strongly keeled; culms hollow; inflorescence solitary, terminal, of several whorled ascending spikes; spikelets densely arranged on the lower sides of a slender triquetrous rachis, alternating in 2 rows but forming a single file, oriented at right angles to the rachis. Spikelets strongly laterally compressed, the glumes and lemmas keeled; first glume narrow, acuminate, 1-nerved; second glume oblong, flattened on the back, markedly bifid at the apex, the single nerve protruding as a short awn; fertile lemma broad, blunt, awnless or nearly so, dark brown and shining, with a short truncate callus; nerves 3, the lateral marginal; palea equalling the lemma; rachilla inflated, bearing a club-shaped truncate rudimentary lemma.

This small genus of ca. 10 species of warm climates of the western hemisphere is closely related to *Chloris*, with which it is often united. It differs in the broad, dark brown, awnless florets, in the placement of the spikelets perpendicular to the rachis rather than appressed to it, in the single file, the oblong, bifid second glume, and the hollow culms. (Chloridoideae: Chlorideae.)



FIG. 81. *Euclasta condylotricha*. A, inflorescence; B, old inflorescence with persistent sessile spikelets; C, rame with awnless basal spikelets and awned upper sessile spikelets.

Eustachys petraea (Swartz) Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2:189. 1810. *Chloris petraea* Swartz, Prodr. Veg. Ind. Occ. 25. 1788. Figure 82.

Perennial, in clumps, the bases with short stout stolons; plants 30-100 cm. tall, erect; culms compressed, glabrous, 2-3 mm. thick, hollow, thick-walled; nodes glabrous; leaves mostly clustered near the bases of the culms, the basal sheaths much overlapping, strongly keeled; foliage glaucous; ligule a minute strongly ciliate membrane, ca. 0.2 mm. long; blades 6-15 cm. long, 4-7 mm. wide, flat or folded, glabrous, scabrous on margins and midrib, strongly keeled beneath, the uppermost much reduced; tip blunt and apiculate. Inflorescence solitary, terminal, vase-shaped, of 3-8 slender spikes, each 4-9 cm. long, the spikelets attached in 2 rows along the lower sides of a slender triquetrous rachis, crowded, placed approximately perpendicular to the rachis; adjacent spikelets intercalated with each other, thus forming a single file. Spikelets 1.6-2.0 mm. long, disarticulating above the persistent glumes; first glume 0.9-1.3 mm. long, 1-nerved, lanceolate, the scabrous keel curved; second glume 1.1-1.5 mm. long, oblong, strongly lobed at the tip, the back rather flat, short-awned from between the lobes; awn 0.3-0.5 mm. long; fertile floret 1.6-2.0 mm. long, the lemma rotund, strongly laterally compressed, dark brown and shining, awnless or minutely apiculate, short-ciliate on the blunt callus, the keel, and the marginal nerves; palea as long as the lemma, obovate, brown and shining, flat; anthers 3, ca. 0.6 mm. long, yellow; rudimentary floret reaching the tip of the fertile lemma, consisting of a club-shaped, truncate, hollow empty lemma, contracted at the base into a thick, fleshy whitish rachilla. Chromosome number $n = 20$ from Costa Rican material.

Sandy beach of the Caribbean Sea, Limón Airport to Boca Banano; Estero Negro; Playa Westfalia. Blooming yearlong. Southeastern United States to Texas and eastern Mexico, Belize, Honduras, Costa Rica and Panama; West Indies. The sporadic occurrence of this species near Caribbean ports in Central America suggests that it may have been introduced. It has grown at Limón at least since 1895.

FESTUCA Linnaeus

Perennial grasses; inflorescence a terminal panicle; spikelets several-many-flowered, laterally compressed, disarticulating above the glumes and between the florets; lemmas with a hard callus, slender, usually 5-nerved, tapering to an acuminate apex or an awn; palea mostly as long as the lemma; anthers 3; flowers chasmogamous.

A large genus of perennial grasses of cold and temperate climates, in the tropics restricted to upper elevations. The genus is often united with *Vulpia*, which differs in containing annual species with one anther and cleistogamous flowers. A few instances of intergeneric hybridization between *Festuca* and *Vulpia* are known. Species of *Festuca* may be confused with certain species of *Bromus*. The latter genus, however, has leaf sheaths with united edges and lemmas with apical teeth, the awn arising between them. (Pooideae: Poeae.)



FIG. 82. *Eustachys petraea*. A, stolon with a cluster of keeled basal leaf sheaths; B, inflorescence; C, portion of a spike; D, a spikelet.

KEY TO SPECIES OF *Festuca*

- 1a. Leaf blades flat, 3-12 mm. wide 2
- 1b. Leaf blades involute or less than 3 mm. wide 5
 - 2a. Lemmas awnless or with awn less than 4 mm. long 3
 - 2b. Lemmas long-awned, awn 10-15 mm. long *F. breviglumis*
- 3a. Bases of leaf blades wider than sheath, auricled; florets 3-10 *F. arundinacea*
- 3b. Bases of leaf blades as wide as sheath, lacking auricles; florets 3-5; native species of forests and alpine sites 4
 - 4a. Lemmas awnless, lowermost 5.5-7.0 mm. long; anthers 2.0-2.8 mm. long, purple; lower panicle branches in 5's; spikelets very numerous .. *F. amplissima*
 - 4b. Lemmas short-awned, lowermost 9-11 mm. long; anthers 3-4 mm. long, yellow; lower panicle branches paired; spikelets few *F. chiriquensis*
- 5a. Lemmas less than 3.5 mm. long, awnless; plants 10-25 cm. tall; leaf blades thread-like *F. tenuifolia*
- 5b. Lemmas 5-8 mm. long, usually awned; plants 15-110 cm. tall 6
 - 6a. Ligule minute; introduced grasses in upper elevation pastures of volcanoes 7
 - 6b. Ligule 1.0-2.5 mm. long; native grasses of páramos above 3,000 m. elevation 8
- 7a. Clumps dense, basal leafy shoots (innovations) arising within the basal sheaths; lower sheaths stramineous, persistent *F. ovina*
- 7b. Clumps loose, sprawling, basal leafy shoots bursting through basal sheaths near their bases; lower sheaths reddish, breaking down into fibers *F. rubra*
 - 8a. Basal leaf blades less than 2.0 mm. wide, with 3-4 coarse ridges on upper surface *F. tolucensis*
 - 8b. Basal leaf blades 2-4 mm. wide, with 6-12 ridges on upper surface
F. dolichophylla

***Festuca amplissima* Rupr. ex Fourn., Mex. Pl. 2:125. 1881. Figure 85.**

Tall, stout perennial; plants 110-150 cm. tall; culms erect from hard bases; basal leaves numerous, their sheaths breaking down into stiff fibers; culms unbranched, stiff, 2-3 mm. thick, hollow, glabrous or scabrous; nodes dark, contracted, glabrous; sheaths nearly as long as the internodes, faintly scabrous; ligules membranaceous, 0.5-1.8 mm. long, the basal ones very short; blades 20-50 cm. long, 7-8 mm. wide, stiff and erect, scabrous beneath, tapering into a long involute tip. Peduncle scabrid, exerted up to 40 cm.; panicle solitary, terminal, up to 30 cm. long, narrowly elliptical; branches up to 5 per node, usually 10-12 cm. long, ascending, naked for several centimeters near the base; rachis, branches, and pedicels angular, scabrous on the edges; spikelets appressed along the branches, their pedicels mostly short. Spikelets laterally compressed, ca. 10 mm. long; first glume 3.0-4.5 mm. long, linear, 1-nerved; second glume 4.8-6.0 mm. long, 3-nerved, lanceolate; florets 3-5, often with a small terminal rudiment; lemmas lanceolate, scabrid, evidently 5-nerved, keeled, awnless, acuminate, often purplish on the back, bronzy near the tip, 5.5-7.0 mm. long; palea nearly as long as its lemma, tapering abruptly to a point, scabrid between the keels; rachilla slender, scabrous; anthers 3, purple, 2.0-2.8 mm. long.

Rare; known from the devastated area at the head of the Río Reventado on Irazú, and from the upper canyon of the Río Talari on Chirripó Grande, at the margin of the páramo; elevations 2,700-3,250 m.

January to April; November. Southern Mexico; Guatemala; Costa Rica; Volcán Chiriqui in Panama. Our specimens have somewhat smaller spikelets and longer ligules than the Pringle specimens 3945 and 9555 cited by Piper in N. Am. Sp. *Festuca*, from Mexico, but are generally similar.

***Festuca arundinacea* Schreb., Spic. Fl. Lips. 57. 1771. Figure 83.**

Perennial, forming large clumps; plants to 150 cm. tall; culms erect to spreading, unbranched, to 5 mm. thick, glabrous; nodes dark, glabrous, shrunk; sheaths elongate, striate; ligules membranaceous, up to 2 mm. long; leaf blades 2-5 per culm, 10-60 cm. long, 3-12 mm. wide, glabrous, coarse and tough, flat, strongly ridged above, the upper surface and margins scabrous, base auricled; basal blades numerous, lying flat on the ground in cropped or grazed plants. Peduncle exserted 10-50 cm.; inflorescence a solitary terminal panicle, erect or nodding, rather narrow and dense; rachis and branches angled and scabrous; spikelets rather densely clustered along the branches, short-pedicellate. Spikelets 10-18 mm. long, the florets crowded because of the short rachilla segments; first glume 3-6 mm. long, 1-nerved, lanceolate; second glume 4.5-7.0 mm. long, 3-nerved, lanceolate-ovate; florets 3-10; lemmas 6-9 mm. long, glabrous, lanceolate-oblong, 5-nerved, tapering to an acuminate apex of a short awn 1-3 mm. long; palea ca. as long as the lemma, the keels scabrous, rachilla segments ca. 1 mm. long, upwardly scabrous; anthers 3, purple, 3.5-4.0 mm. long. Chromosome number $n = 21$.

Moist pastures, Irazú and Turrialba, 1,800-2,800 m. elevation. August to November, probably yearlong. Introduced from Europe as a pasture grass; naturalized in various parts of North America. This species was apparently reported as *F. elatior* L. in the *Grasses of Central America*.

***Festuca breviglumis* Swallen, Contr. U.S. Natl. Herb. 29:398. 1950. Figure 84.**

Perennial; culms erect or the bases decumbent; plants to 130 cm. tall; culms unbranched, 3 mm. thick, glabrous, hollow; nodes dark, shrunk, glabrous; culm leaves ca. 4, their sheaths very elongate, up to 25 cm. long, glabrous; ligules 0.5-0.8 mm. long, membranaceous, minutely ciliate; blades flat or folded, up to 35 cm. long, 5-7 mm. wide, glabrous, the upper surface finely nerved; lower surface scaberulous. Panicle solitary, terminal, up to 27 cm. long, 15 cm. wide, open, nodding; branches paired, the longest 18 cm. long; rachis and branches scabrous, the lower third to half of the branch devoid of spikelets. Spikelets few, 15-20 mm. long without the awns; first glume 3-5 mm. long, 1-nerved, acicular; second glume 6.5-8.5 mm. long, narrowly lanceolate, 3-nerved; florets 4-5; lemmas narrowly lanceolate, rounded on the back, the upper portion folded and keeled, evidently 5-nerved, but with an extra pair of weak marginal nerves near the base, scabrid on the back, tapering to an awn up to 15 mm. long; lowermost lemma 14.0-15.5 mm. long, the upper ones shorter; palea narrowly elliptical, tapering to a narrow tip, scabrous on the nerves, two-thirds to three-fourths as long as the lemma; rachilla scabrous, the ultimate segment sterile or bearing a long-awned rudiment at its tip; anthers 3, purple, 4.0-4.5 mm. long.

Rare; known in Costa Rica only from the type from Copey, and from

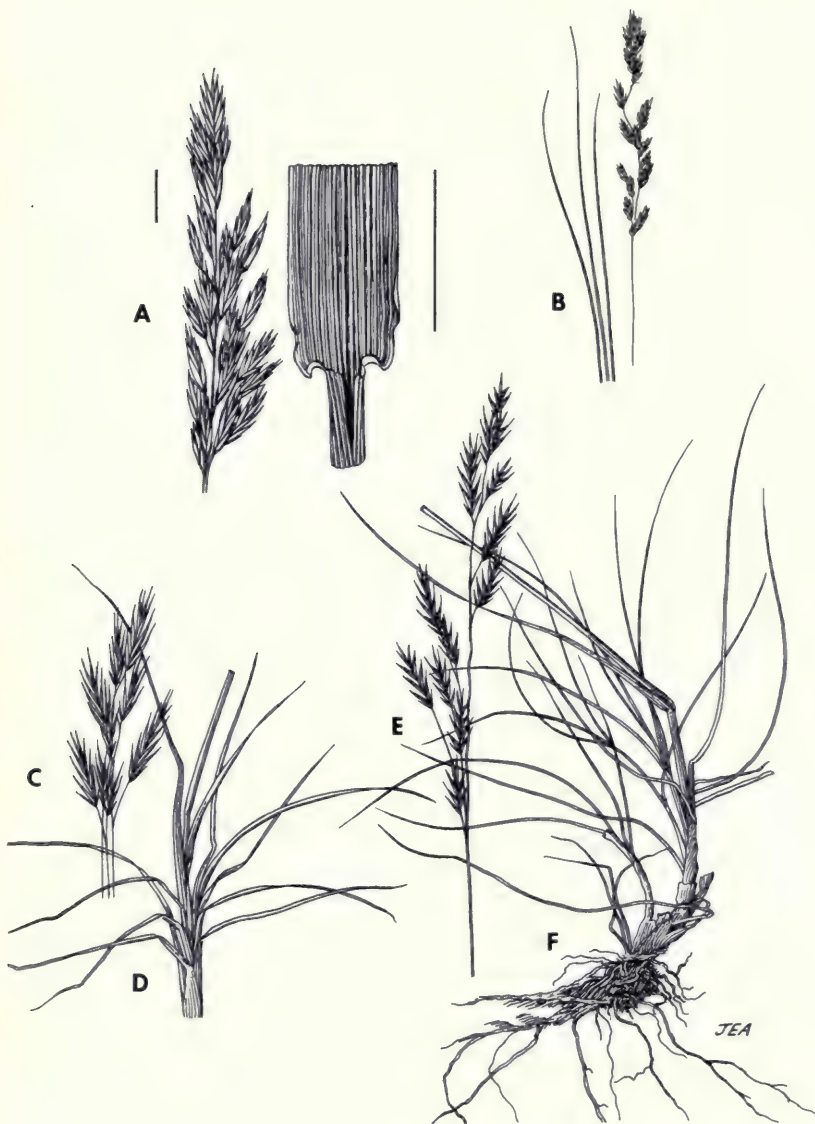


FIG. 83. *Festuca* species. *F. arundinacea*: A, portion of panicle and ridged upper surface of leaf blade; *F. tenuifolia*: B, panicle and threadlike leaf blades; *F. ovina*: C, portion of panicle; D, leafy shoot with intravaginal branching; *F. rubra*: E, panicle; F, base of plant with extravaginal branching.



FIG. 84. *Festuca* species. *F. breviglumis*: A, panicle; B, culm base; C, spikelet; *F. chiriquensis*: D, spikelet.

a recent specimen collected along the Carretera Interamericana north of San Cristobal Norte; elevations 2,000-2,200 m. September to December. Also known from Guatemala.

Festuca chiriquensis Swallen, Ann. Missouri Bot. Gard. 30:116. 1943. Figure 84.

Perennial, in small clumps from a deep-seated base; plants 80-130 cm. tall; culms unbranched, 2-3 mm. thick, glabrous, hollow; culm leaves ca. 4; sheaths glabrous, much shorter than the internodes, scabrid; ligule a minutely ciliate membrane, 0.7-2.0 mm. long; blades soft, flat, dark green and shining, slightly scabrid, 15-50 cm. long, 4-7 mm. wide. Peduncle exerted to 15 cm.; inflorescence a solitary terminal panicle, open, nodding, few-flowered, 15-30 cm. long; branches few, paired, the longest 15 cm. long, the spikelets borne on the outer third. Spikelets 3-4-flowered, 15-17 mm. long; first glume subulate, 1-nerved, 5.5-6.7 mm. long; second glume linear-lanceolate, 3-nerved, scabrous on the keel, 8.0-9.5 mm. long; lowermost lemma 9-11 mm. long, lanceolate, conspicuously 5-nerved, scabrous, minutely toothed at the apex; awn stiff, scabrous, 1-4 mm. long; palea equal to the lemma, scabrous on the keels, nerves prolonged into awns up to 1 mm. long; rachilla scabrous; anthers 3, yellow, 3.0-3.9 mm. long.

Moist oak forests, Chirripó Grande, 3,000-3,200 m. elevation. The type was from Volcán Chiriqui in Panamá. September to April. This rare species was previously known only from the type. It is very similar to *F. breviglumis*, from which it differs in having much longer glumes, shorter lemmas, longer paleas which are awned, and smaller yellow anthers.

Festuca dolichophylla Presl, Rel. Haenk. 1:258. 1830. Figure 85.

Perennial, in large, dense clumps; plants erect, 65-110 cm. tall; culms unbranched, hollow, glabrous, 2-4 mm. thick; internodes very elongated; nodes dark, shrunken, glabrous; sheaths glabrous, about as long as the internodes; ligules membranaceous, 1.0-2.5 mm. long; leaves mostly basal; blades elongate, up to 50 cm. long, erect, involute, glabrous or scabrous beneath, puberulent or glabrous above, 2-5 mm. wide, upper surface with 6-12 strong ridges. Peduncle glabrous or slightly scaberulous, up to 15 cm. long; panicle terminal, solitary, narrowly elliptical, nodding, 10-25 cm. long, 3-4 cm. wide; lower branches usually paired, up to 12 cm. long, ascending; spikelets appressed along the branches. Spikelets 10-17 mm. long, usually purple, with 5-7 florets; first glume linear-triangular, 1-nerved, 4-6 mm. long; second glume linear-lanceolate, 3-nerved, 6.0-7.2 mm. long; lemmas obscurely 5-nerved, narrowly lanceolate, more or less scaberulous, 6.5-8.0 mm. long, rounded on the back, the margins infolded; apex acuminate or short-awned, the awn less than 1 mm. long; palea nearly as long as the lemma, narrowed to the tip, scabrous on the keels; rachilla segments slender, scabrous, the terminal one half as long as the floret below, naked or bearing an abortive floret at its tip. Chromosome number $n = 21$ from Costa Rican material.

Volcanic cinders and mud about the craters of Irazú and Turrialba, Chirripó Grande; elevations 3,100-3,400 m. June to August. Costa Rica; Volcán Chiriqui in Panamá; to Chile.

This species is similar to *F. amplissima*, but differs in the stiff,



FIG. 85. *Festuca* species. *F. dolichophylla*: A, panicle and leaf blades; B, spikelet; *F. amplissima*: C, panicle; D, leaf sheath and blade; E, spikelet.

involute narrow leaves, paired panicle branches, larger spikelets with more florets. It also resembles *F. tolucensis* of Mexico, but differs in the much coarser foliage.

***Festuca ovina* L., Sp. Pl. 73. 1753. Figure 83.**

Densely caespitose perennial; intravaginal innovations numerous, most of the foliage borne near the base of the plants; culms 15-60 cm. tall; leaf blades of innovations and culms stiff, folded; foliage glabrous. Inflorescence a solitary terminal panicle, usually 5-10 cm. long, with few ascending branches, the spikelets clustered near the tips. Spikelets with 3-9 florets; lemmas short-awned, rounded on the back, stiff.

This is a widespread and extremely polymorphous European species, not previously reported from Central America and known only from the following Costa Rican specimen. A number of European pasture grasses occur in these alpine pastures, and were evidently introduced long ago in pasture seed mixtures. Cartago, in pasture, upper slopes of Volcán Irazú, *Godfrey 66649*, 24 February 1965.

***Festuca rubra* L., Sp. Pl. 74. 1753. Figure 83.**

Perennial, in loose, sprawling tufts; plants 15-90 cm. tall; the bases of the culms often decumbent or creeping; foliage mostly basal, the innovations extravaginal; culms ca. 1 mm. thick, hollow, ridged, glabrous; old basal sheaths becoming dark reddish, eventually breaking down into loose fibers; ligule a minute membrane; blades 3-40 cm. long, mostly folded, appearing 0.5-1.0 mm. wide as folded, as much as 2 mm. wide when flat. Peduncle elongate, as much as half the height of the plant; panicle solitary, terminal, 3-17 cm. long, slender, erect or nodding; branches solitary or paired, the longest up to 6 cm. long, angled and scabrous, few-flowered; spikelets overlapping. Spikelets 5-14 mm. long, with 3-9 florets; first glume 2.0-3.5 mm. long, 1-nerved, narrowly lanceolate; second glume 3.5-5.0 mm. long, 3-nerved, lanceolate; lemmas 5-6 mm. long, lanceolate, 5-nerved, glabrous or scabrid toward the tip, tapering into a stiff awn 1-3 mm. long; palea equal to the lemma, scabrid on the keels; anthers 3, 2-3 mm. long, purple.

Pastures and clearings, upper slopes of Volcán Barba and Volcán Turrialba; elevations 2,400-2,800 m., rare. June to August. This species is widespread in cooler regions of the northern hemisphere and is extensively cultivated as a lawn grass. In Central America, it is known only from Costa Rica. Our collections are undoubtedly survivals from pasture seed mixtures imported from Europe, since they grow in areas harboring numerous European plants.

***Festuca tenuifolia* Sibth., Fl. Oxon. 44. 1794. *F. capillata* Lam., Fl. Franc. 3:597. 1778. Figure 83.**

Perennial, in dense clumps with numerous erect basal blades; plants 10-25 cm. tall; culms thin, hollow, glabrous or scaberulous; leaf blades hairlike, rolled, less than 0.5 mm. thick; ligule a minute membrane; sheaths with small auricles; peduncle slender, half the height of the plant. Inflorescence a solitary terminal panicle, 2-10 cm. long, linear,

with short, erect, few-flowered scabrous branches. Spikelets 3-7 mm. long, 3-8-flowered; first glume 1-nerved, lanceolate, 1.5-2.5 mm. long; second glume 3-nerved, ovate, 2.5-3.5 mm. long; lemmas 2.5-3.5 mm. long, ovate, acuminate, awnless, 5-nerved, glabrous or scabrid near the tip; palea as long as the lemma; anthers 3, 1-2 mm. long, yellow or purple.

Moist pasture, south slope of Volcán Turrialba, elevation 3,000 m. August. This species is European and has been introduced sparingly in the northern United States. The collection indicated above is apparently the first from Central America. The plants occurred in an area where numerous grasses of European origin grow. Probably, this species was introduced in pasture seed mixtures.

***Festuca tolucensis* H.B.K., Nov. Gen. & Sp. 1:153. 1816.**

Caespitose perennial in dense tufts; culms erect, up to 100 cm. tall; unbranched; foliage mostly aggregated near the base of the plants; internodes glabrous, 1.5-2.0 mm. thick; nodes dark, contracted; leaf sheaths glabrous, granular-roughened; ligule a thin membrane, 1.0-2.5 mm. long; basal leaf blades up to 25 cm. long, scabrous, involute, 1.0-1.5 mm. wide, the upper surface 3-4-ridged, scaberulous; basal foliage reaching one-half to two-thirds the height of the plants, the upper portions of the culms nearly leafless. Peduncles exerted up to 30 cm.; inflorescences solitary, terminal; panicles 11-20 cm. long, open but narrow, few-flowered; branches paired or solitary. Spikelets usually purplish, 9-14 mm. long; 6-8-flowered; first glume 4.5-6.3 mm. long, narrowly triangular, 1-nerved; second glume 6.0-7.4 mm. long, ovate, acute, 3-nerved; lemmas narrowly ovate, acuminate or awn-tipped, 6-8 mm. long, scaberulous; palea slightly shorter, bifid at the tip; anthers 3, yellow, 2.8-3.4 mm. long.

Rare; summit of Irazú; Valle de los Conejos, Chirripó. Apparently blooming yearlong. Southern Mexico (Toluca); Guatemala; Costa Rica.

This species is difficult to distinguish with certainty from *F. dolichophylla*. The very slender, elongate, scabrous basal foliage blades are the best character, but some individuals are intermediate. The chromosome number of $n = 21$ has been previously reported and is the same as that of Costa Rican *F. dolichophylla*. The spikelets of our material are a good match for type fragments of *F. tolucensis* in US.

GLYCERIA R. Brown

Perennial aquatic or paludose grasses; sheaths with united edges; inflorescence a panicle; spikelets several-many-flowered, terete or compressed, disarticulating very readily above the glumes and between the florets; glumes usually 1-nerved, blunt; lemmas 5-9-nerved, the nerves conspicuous, not converging but running parallel from base to the usually blunt apex. (Pooideae: Meliceae.)

***Glyceria plicata* (Fries) Fries, Nov. Fl. Suec. Mant. III:176. 1842.**
G. fluitans var. *plicata* Fries, Nov. Mant. II:6. 1839. Figure 86.



FIG. 86. *Glyceria plicata*. A, spikelet; B, lemma; C, panicle.

Culms 30-75 cm. long, the basal portion creeping and much-branched, the upper part ascending, not branched, glabrous, rather succulent, hollow; sheaths mostly overlapping, slightly roughened; ligules brownish, membranaceous, 2-8 mm. long, decurrent on the sheath margins; blades 5-30 cm. long, 3-14 mm. wide, flat or folded, scabrid beneath, tapering abruptly to an acute apex. Peduncle mostly included, smooth; inflorescence solitary, terminal, 20-25 cm. long, cylindrical, strict when young but the branches spreading in fruit; branches whorled, with up to 7-8 spikelets; pedicels 1.0-7.5 mm. long; spikelets mostly appressed to the branchlets, nearly terete, 10-25 mm. long; florets 7-15; first glume 1.5-2.5 mm. long, 1-nerved; second glume 2.5-4.0 mm. long, 1-nerved, both glumes ovate, blunt; lemmas 3.5-5.0 mm. long, oblong, blunt, conspicuously 7-nerved, scabrid on the nerves, with a purple band below the whitish, membranaceous apex; palea nearly as long as the lemma, glabrous, with thickened keels, the apex blunt; anthers 3, 0.8-1.5 mm. long, yellow or rarely purplish. Chromosome number $n = 20$.

This European species has not previously been reported from the western hemisphere. At the spot where we collected it, it was growing in a moist meadow along with *Poa trivialis*, another European species. It is probable that this species, like a number of others from highland pastures, represents a survival from accidental introduction in European pasture seed mixtures. The following is our only collection: Cartago, Hacienda Las Virtudes, SE of Volcán Irazú, 2,650 m., 14 February 1969, Pohl & Davidse 11715.

GOUINIA Fournier

REFERENCE: J. R. Swallen, The grass genus *Gouinia*. Amer. J. Bot. 22:31-41. 1935.

Caespitose perennial grasses; inflorescence a terminal panicle, the branches mostly simple, the spikelets pedicellate in 2 rows along the lower side of the slender branches. Spikelets with 2 or more florets, disarticulating above the glumes and between the florets; glumes 1-several-nerved, shorter than the spikelets; lemmas 3-nerved, lanceolate, long awned from the acuminate apex, ciliate on the callus and nerves; rachilla slender, the internodes long; palea bidentate or awned, glabrous or pubescent.

The genus, containing 13 species of tropical American grasses, is related to *Leptochloa*. (Chloridoideae: Eragrosteae.)

Gouinia virgata (Presl) Scribn., Bull. U.S.D.A. Div. Agrost. 4:10. 1897. *Bromus virgatus* Presl, Rel. Haenk. 1:263. 1830. Figure 87.

Culms erect, 30-150 cm. tall, unbranched, glabrous, solid, pithy; nodes glabrous; sheaths slightly keeled above, shorter or longer than the internodes, glabrous or slightly hispid about the collar and base of the blade; ligule a ciliate membrane, 0.5-1.5 mm. long; blades up to 25 cm. or more long, 4-15 mm. wide, glabrous, tapering to a narrow base, margins scabrous. Panicle 10-15 cm. long, open, with few, solitary, mostly simple branches, stiffly spreading, 8-20 cm. long, spikelets lying parallel to the lower sides of the branches; pedicels 1-4 mm. long, angular. Spikelets 10-12 mm. long, excluding the awns, slender; disarticulation above the glumes and between the florets; first glume



FIG. 87. *Gowinia virgata*. A, panicle; B, glumes, C, floret.

3.9-5.2 mm. long, 3-4-nerved, lanceolate; second glume 5.7-7.2 mm. long, 5-7-nerved, narrowly ovate; florets 2-3; lemmas 8-10 mm. long, lanceolate, acuminate, with a sharp bearded callus, the nerves and margins silky-ciliate on the lower half; awn from the tip, 8-15 mm. long; upper florets shorter than the lowermost; palea 7-8 mm. long, silky-ciliate on the keels; anthers 3, 0.5-0.6 mm. long. Chromosome number $n = 20$ from Costa Rican specimens.

Open forests near the Pacific Ocean, elevations below 100 m.; Cuajiniquil and Puerto Castillo, Hacienda Murcielago; Finca la Pacifica, Cañas, Isla de Chirra. October to January. Mexico to Guanacaste; Colombia to Peru and Ecuador; Cuba and Haiti.

GYMNOPOGON Beauvois

REFERENCE: J. P. Smith, Jr., Taxonomic revision of the genus *Gymnopogon* (Gramineae), Iowa State Univ. J. Sci. 45:319-385. 1971.

Perennial or annual caespitose or rhizomatous grasses; culms simple or sparingly branched; leaf blades lacking a midrib, usually stiffly spreading. Inflorescence a panicle of several erect or spreading slender spikelike racemes; rachis of racemes triquetrous; spikelets alternating in 2 rows on 2 sides of the rachis and parallel to it. Spikelets 1-2-flowered, the ultimate floret reduced to a thin awnlike body; disarticulation above the glumes; glumes 1-nerved, narrow, acuminate, keeled, both longer than the florets; lemma very faintly 3-nerved, its apex minutely bifid, usually bearing an awn that arises below the tip; palea 2-nerved, equal to the lemma; rachilla prolonged above the fertile floret and usually bearing a slender rudiment; caryopsis terete to angular.

Gymnopogon is a small genus of about 13 species, confined to warm regions of the western hemisphere, with one species in Southeast Asia. The genus is closely related to *Chloris*, differing mostly in the stiff leaf blades, lacking midribs, the long, equal glumes, and the absence of a well-developed sterile upper floret. (Chloridoideae: Chlorideae.)

***Gymnopogon fastigiatus* Nees, Agrost. Bras. 430. 1829, ssp. *fastigiatus*. Figure 88.**

Caespitose perennial; culms glabrous, erect to spreading, 35-80 cm. long, simple or sparingly branched from the middle nodes; sheaths glabrous except for sparse auricular pilosity at the throat; ligule a minute ciliolate membrane, ca. 0.1-0.2 mm. long; leaf blades glabrous, flat or involute, 2.0-4.5 cm. long, 1-4 mm. wide, subcordate at the base, stiffly ascending. Peduncle included or exserted up to 7 cm.; inflorescence a raceme of 3-11 spikes, each 3-7 cm. long, spikelet-bearing to the base, ascending; axis triquetrous, scabrous. Spikelets 1-flowered; glumes subequal, acuminate, 1-nerved, the keel scabrous; lemma faintly 3-nerved, glabrous on the back and sides, the margins pubescent, long-pilose at the summit; apex bifid, bearing a tortuous awn 8-15 mm. long from just below the bifid tip; palea membranaceous, 2-nerved; rachilla segment nearly as long as the lemma, lying between the keels of the palea, lacking a rudimentary second floret; anthers 3, ca. 0.7 mm. long; caryopsis 1.3-1.8 mm. long. Chromosome number $n = 20$.



FIG. 88. *Gymnopogon fastigiatus* ssp. *fastigiatus*. A, inflorescence; B, portion of a spike; C, floret with prolonged rachilla internode.

Rare; in steep gullies, savannas of Boruca; reported from this area by Standley. The following is the only recent specimen: Puntarenas, Savanas de Boruca, elevation 380 m., *P. & D. 11614*. Blooming during the short days of the dry season. Costa Rica, Panama, northern South America from Colombia to Bolivia and Brazil.

GYNERIUM Humboldt & Bonpland

REFERENCE: H. J. Conert, *Die Systematik und Anatomie der Arundineae*, Cramer Verlag. Weinheim. 208 pp. 1961.

Giant rhizomatous perennial grasses, forming large colonies; culms erect to arching, solid and semi-woody, the lower parts clothed with bladeless sheaths, the upper end with a large fan-shaped cluster of distichous leaves; dioecious, the staminate and the pistillate plants frequently in separate colonies. Inflorescence a very large terminal panicle borne on an elongated solid peduncle, the branches drooping along the rachis; pistillate panicles plumose; spikelets laterally compressed, disarticulating above the glumes and between the florets, usually 2-flowered. (Arundinoideae: Arundineae.)

Gynerium sagittatum (Aubl.) Beauv., *Ess. Nouv. Agrost.* 138. 1812. *Saccharum sagittatum* Aubl., *Pl. Gui.* I:50. 1775. Figure 89.

Culms up to 10 m. tall, 2-5 cm. thick, simple or with extravaginal branches; leaf blades with a conspicuous midrib, 40-200 cm. long, 2-8 cm. wide, cottony on the midrib above the base, very scabrous on the margins; ligule a minute ciliolate membrane; nodes level with surface of the culm, glabrous. Peduncle 1 m. or more long, 1 cm. or more in diameter, smooth; panicles up to 1.5 m. long, the very slender branches emerging from the rachis in clusters, drooping along the rachis; spikelets pedicellate, in dense clusters along 3rd- or 4th-order branches. Pistillate spikelets: 8-10 mm. long, plumose; first glume 1-nerved, narrow, hyaline, ca. 3 mm. long; second glume longer than the florets, linear, faintly 3-nerved, 7-10 mm. long, light brown, thinly membranous, the upper two-thirds with inrolled margins, the keel recurved. After the fall of the florets, the glumes may also disarticulate. Florets 2; disarticulation at the base of the rachilla joints; lowermost lemma ca. 5 mm. long, the upper shorter; lemmas tapering into a slender inrolled awnlike beak, abundantly long-silky hairy on the basal half, the beak portion glabrous; callus bearing short erect hairs; palea ca. 1 mm. long, linear, glabrous except at the tip; lodicules 2, truncate; pistil with 2 terminal styles, terminating in feathery purple stigmas; staminodia may be present. Staminate spikelets: not plumose, ca. 3 mm. long, laterally compressed, disarticulating above the glumes and at the base of the upper floret; glumes about equal, 2 mm. long, 1-nerved, lanceolate, hyaline, brownish; lemmas 2.0-2.5 mm. long, narrowly ovate, 1-nerved, purplish, sparsely puberulent at the base or occasionally with a few long hairs on the upper portion; palea blunt, nearly as long as the lemma; lodicules 2, truncate; anthers 2, 1.5-2.0 mm. long, yellow. A rudimentary ovary may be present. Chromosome number $n = 22$ from Costa Rican specimens.

This species forms conspicuous large colonies along the margins of major streams and occasionally elsewhere, from sea level up to about 1,100 m. The stems are harvested in large quantities and used in rustic construction and as banana props. Blooming is apparently yearlong.



FIG. 89. *Gynerium sagittatum*. A, panicle; B, branchlet from a pistillate panicle; C, pistillate spikelet; D, branchlet from a staminate panicle; E, staminate spikelet.

Southern Mexico to Peru and northern Paraguay and Brazil; West Indies. Common name: *Caña brava*.

HACKELOCHLOA Kuntze

Caespitose, much-branched annual; inflorescences numerous, terminal and axillary solitary dorsiventral pedunculate rames, exerted in clusters from the middle and upper sheaths; spikelets paired at each node of a flat disarticulating rachis; sessile spikelet of each pair spheroidal, rigid, the first glume much inflated, the upper portion round, blackish, its surface covered with square pits in transverse rows, its margins clasping the edges of the united rachis joint and pedicel, the base smooth and white, contracted; second glume appressed to the rachis joint, oblong, blunt, slightly keeled, chartaceous, 3-nerved; flower perfect. Pedicellate spikelet very different from the sessile one and larger, its first glume flat, ovate, acute, green and herbaceous, many-nerved, clasping the margins of the second glume by 2 flanges borne near the margins on the inner side; second glume folded, strongly wing-keeled, as long as the first; inner parts usually absent. Occasional spikelets may possess sterile lemma, fertile lemma and palea, and a staminate flower. All the inner bracts are hyaline and nerveless.

One species, native to the tropics of the Old World but widespread in the warmer regions of both hemispheres. (Panicoideae: Andropogoneae.)

Hackelochloa granularis (L.) Kuntze, Rev. Gen. Pl. 2:776. 1891. *Cenchrus granularis* L., Mant. Pl. 2:575. 1771. *Rottboellia granularis* (L.) Roberty, Monogr. Androp. 79. 1960. Figure 90.

Tufted, much-branched annual; erect, often with prop-roots; culms from very short to 120 cm. long, solid, pithy, more or less pustulose-hispid, especially toward the apex of the internodes; sheaths much shorter than the internodes, inflated, keeled, the margins silky, the surface prominently pustulose-hispid; ligule arched, a ciliate membrane 1.0-1.5 mm. long; leaf blades flat, 2-20 cm. long, 4-15 mm. wide, pustulose-hispid on both surfaces and on the margins. Peduncles bracted, arising in small groups from all the middle and upper nodes of the culms, slightly exerted; rames slender, stiff, 7-15 mm. long. Spikelets paired, the sessile ones in 2 rows alternating along one side of the rachis, the pedicellate ones on the opposite side. Sessile spikelets 1.3-1.7 mm. long, falling attached to the rachis joint, pedicel, and pedicellate spikelet; first glume rigid, sub-spherical or turbinate, its opening completely closed off by the chartaceous second glume; second glume 0.8-1.0 mm. long; fertile lemma and palea hyaline, nerveless, ca. 0.9 mm. long; flower perfect; anthers 0.2-0.3 mm. long. Pedicellate spikelet 1.5-2.0 mm. long. Chromosome number $n = 7$ from Costa Rican specimens.

Open dry weedy areas, common at low elevations and ascending to 1,100 m.; both Caribbean and Pacific slopes; particularly common in Guanacaste. July to December. This species occurs in the western hemisphere as an introduction, from southern United States through Central America; Caribbean Islands.

This peculiar grass is at once recognizable by the tiny spheroidal,



FIG. 90. *Hackelochloa granularis*. A, B, two views of a spikelet pair; C, flowering culm.

blackish, pitted, fertile spikelets. The sheaths are pungent-bristly to the touch.

HIEROCHLOË R. Brown Nomen Conservandum

Rhizomatous perennials; culms simple; inflorescence a terminal panicle; spikelets of 3 florets, disarticulating only above the subequal enlarged membranaceous glumes, the florets remaining attached to each other; lower 2 florets subequal, longer than the fertile floret; staminate or neuter; lemmas 5-nerved, usually awned below the tip or from the back; palea usually present (absent in our species); stamens, if present, 3, the anthers large; terminal floret with a blunt, 3-5-nerved lemma, awnless or nearly so; palea somewhat shorter than the lemma, 1-nerved; stamens 2, usually rudimentary; stigmas 2; plants with the odor of coumarin.

A small genus of Arctic, alpine and cool temperate grasses, mostly in the northern hemisphere but extending to South America. The sweet vanilla-like odor of the plants, due to the presence of coumarin, aids in their recognition. (Pooideae: Phalarideae.)

***Hierochloë davidsei* Pohl, Iowa State J. Res. 47:71. 1972. Figure 91.**

Rhizomatous perennial; culms erect, 30-60 cm. tall, unbranched, glabrous, hollow, 2-3 mm. thick, arising singly or in small clumps from slender rhizomes; the rhizomes up to 9 cm. long, often giving rise to leafy innovations; leaves 5-7 per culm; lower sheaths short and overlapping, the upper one or two much shorter than the internode, strongly ribbed, glabrous or occasionally retrorsely pilose, especially near the apex; ligules 1.5-5 mm. long, the upper ones longer than the lower, whitish, membranaceous, densely retrorsely pilose on the outer surface, truncate; leaf blades 5-8 mm. wide; 6-15 cm. long, the mid-culm blades largest, all rather blunt, pilose above; peduncle 10-15 cm. long, slender, erect, glabrous; inflorescence a single narrowly cylindrical terminal panicle, sometimes slightly lobulate below, 3-11 cm. long, the branches erect; pedicels 1-3 mm. long, slightly pilose; spikelets 5.5-6.5 mm. long, ovate, laterally compressed, brownish; glumes thin and membranaceous, ovate, acute, overlapping, the first 4-4.5 mm. long, 1-nerved, the second 5.5-6.5 mm., 3-nerved; florets 3; lower 2 florets sterile, lacking flower and palea, both ca. 5 mm. long; sterile lemmas 5-nerved, brownish, ciliate; first lemma with a short straight awn born ca. 1 mm. below the lobed apex and reaching to the tip; second lemma similar, but bearing a bent awn attached slightly below the middle of the lemma, below a lobed apex; awn 4-5.5 mm. long, twisted below, exserted laterally from the glumes 1-2 mm.; fertile lemma 3 mm. long, thin and membranaceous, glabrous, 5-nerved, blunt, cucullate, awnless, or with a short straight awn, bifid at the apex; palea about equal, oblong, acute; anthers 2, ca. 1.5 mm. long, yellow; lodicules minute, evidently functionless.

Chromosome number $n = 28$, determined from microsporocytes of the type: Prov. de San José, Páramo along Carretera Interamericana at km. 86, elevation 3,030 m., 23 August 1968, *Pohl & Davidse 11004*.



FIG. 91. *Hierochloë davidsei*. A, blooming plant; B, spikelet; C, two lower sterile florets and fertile terminal floret.

This species is similar to *H. mexicana*, from which it differs in the following characteristics:

Character	<i>H. davidsei</i>	<i>H. mexicana</i>
leaf blade L/W ratio	11/1-12/1	20/1-30/1
ligule	very pilose	glabrous
lower 2 florets	without flower and palea	often with flower and palea
anther length (mm.)	1.5	4

In having sterile lower florets, this species resembles species of *Anthoxanthum*. The latter genus, however, has a basic chromosome number of 10, and the spikelets have very unequal glumes. *Hierochloë davidsei* has a basic chromosome number of $X = 7$ ($n = 28$) and sub-equal glumes. Certain specimens from Guatemala approach the Costa Rican species, but have anthers 2.5-3 mm. long and are probably best assigned to *H. mexicana* on other characters. This species is named for Gerrit Davidse, who discovered the plants. It is known from the type locality and from La Asunción (*Burger & Gomez 7936*) and Chirripó Grande (*Burger & Gomez 8212*). It should be looked for elsewhere on the high paramos. Elevations 3,000-3,450 m. Blooming in August from the three known specimens.

HOLCUS Linnaeus

Caespitose or rhizomatous perennials; inflorescence a terminal panicle; spikelets compressed and keeled, 2-flowered; glumes equal, longer than the florets; disarticulation below the glumes; florets similar, but the lower one with a perfect flower, the upper staminate; upper lemma bearing a short, thick awn. (Pooideae: Aveneae.)

Holcus lanatus L., Sp. Pl. 1048. 1753. Figure 92.

Caespitose perennial; culms 20-100 cm. tall, erect from decumbent bases, unbranched, hollow and thin-walled, velutinous; nodes velvety; leaves 3-5 per culm; sheaths mostly overlapping; ligules 1.5-3 mm. long, membranaceous, decurrent on the sheaths, ciliate, puberulent on the back; blades soft, grayish-green, velutinous, 4-20 cm. long, 3-10 mm. wide. Panicle solitary, contracted or lax, cylindrical to pyramidal, pale or pinkish or purplish. Spikelets closely arranged, overlapping, short-pedicellate, strongly compressed and keeled; glumes about equal in length, 4.0-4.5 mm. long, overlapping; first glume ovate, 1-nerved, second broadly ovate, 3-nerved; both ciliate on nerves and keel, puberulent on the internerves; florets 2, smooth and shining, completely hidden in the glumes; lower floret awnless, the upper with a short, hook-shaped awn from just below the apex; lemmas 2.0-2.3 mm. long, faintly 3-nerved; paleas slightly shorter than the lemmas, scabrid on the keels; anthers 3 in each floret, purplish, 1.7-2.2 mm. long. Chromosome number $n = 7$ from Costa Rican specimen.



FIG. 92. *Holcus lanatus*. A, panicle; B, spikelet; C, florets.

Pastures, open areas, roadsides; common in moist areas from 1,600-3,200 m. elevation, Cordillera Central and Cerro de la Muerte. Blooming is probably yearlong. This species is native in Eurasia and northwest Africa. It is widely naturalized in temperate North America. In Costa Rica, it was introduced as a forage crop, but is probably little used as such now.

HOMOLEPIS Chase

Stoloniferous grasses; inflorescence a terminal panicle. Disarticulation below the glumes; spikelets lanceolate, acuminate, dorsally compressed; glumes concealing the florets, subequal or the first somewhat longer than the second, its margins covering the edges of the second; first glume 7-9-nerved, ovate; second glume 7-nerved; sterile lemma 7-nerved, strongly ciliate between the marginal nerves, its palea small, membranaceous; fertile floret chartaceous, acuminate, the lemma obscurely nerved, glabrous and shining, with thin exposed margins overlapping the margins of a palea of similar length and texture. (Panicoideae: Paniceae.)

Homolepis aturensis (H.B.K.) Chase, Proc. Biol. Soc. Wash. 24:146. 1911. *Panicum aturense* H.B.K., Nov. Gen. & Sp. 1:103. 1816. Figure 93.

Duration indefinite; plants extensively stoloniferous; erect or ascending floriferous branches 20-50 cm. long arising from the stolons; culms glabrous, hollow, 1-2 mm. thick; nodes glabrous; sheaths usually shorter than the internodes, glabrous or pilose, silky-ciliate on the margins, keeled; ligule a minutely ciliate membrane, 0.4-0.7 mm. long; a puberulent line across the collar; blades cordate above a brief pseudopetiole, flat, 4-12 cm. long, 7-20 mm. wide, glabrous to pilose or velutinous on the surfaces; peduncle included or exserted up to 12 cm.; uppermost leaf blade much reduced; panicles terminal on the culms or on leafy branches, narrowly elliptical, 6-9 cm. long, 2-5 × longer than wide; spikelets on slender pedicels, rather crowded, 7.0-7.7 mm. long; first glume 7-9-nerved, ovate, the margins overlapping the edges of the second; second glume 6.4-6.8 mm. long, 7-nerved, the margins ciliate near the base; sterile lemma 7-nerved, 5.2-6.8 mm. long, 7-nerved, strongly silky-ciliate between the marginal pairs of nerves; fertile lemma 4.8-6.0 mm. long, lanceolate, the nerves faint, its palea similar; anthers 3, purple, 1.3-1.6 mm. long. Chromosome number $n = 10$ from Costa Rican material.

Moist pastures, shaded roadsides, sea beaches, from sea level to 1,200 m. elevation, on both Caribbean and Pacific slopes. June to March. Southern Mexico to Bolivia and Brazil.

HYMENACHNE Beauvois

Aquatic or paludose perennials of tall stature; culm internodes filled with spongy aerenchyma. Inflorescence a dense narrowly cylindrical or spikelike terminal panicle. Spikelets lanceolate-acuminate, dorsally compressed; first glume 1-3-nerved, much shorter than the spikelet, a definite internode of the rachilla between the first and second glumes; second glume and sterile lemma 3-5-nerved, subequal, both longer than the



FIG. 93. *Homolepis aturensis*. A, panicle; B, stolon with leafy shoots; C, two views of a spikelet.

perfect terminal floret; sterile lemma lacking a palea; fertile lemma lanceolate, chartaceous, smooth and glabrous, very faintly nerved, its margins thin, not inrolled; palea nearly as long as the lemma and of similar texture.

A genus of about 10 species of New World and Asiatic tropics, closely related to *Sacciolepis* and differing from it in having solid internodes. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Hymenachne*

- 1a. Spikelets 3.5-5.5 mm. long; second glume and sterile lemma 5-nerved, acuminate; panicles spikelike *H. amplexicaulis*
- 1b. Spikelets 2.5-2.9 mm. long; second glume and sterile lemma 3-nerved, acute; panicle narrowly cylindrical, tapering, with ascending branches *H. donacifolia*

Hymenachne amplexicaulis (Rudge) Nees, Agrost. Bras. 276. 1829. *Panicum amplexicaule* Rudge, Pl. Gui. 1:21, pl. 27. 1805. Figure 94.

Tall perennial, the culms to 3.5 m. long, arising from long decumbent rooting bases; culms thick and spongy, the interior filled with stellate aerenchyma, glabrous; nodes glabrous, with swollen sheath pulvini; sheaths much shorter than the internodes, glabrous, or the margins papillose-ciliate; ligule a thin brownish membrane, 1.0-2.5 mm. long; blades soft, flat, glabrous, 15-33 cm. long, 12-28 mm. wide, the margins strongly scabrous, pustulose-ciliate on the cordate-clasping basal lobes. Peduncle glabrous, usually included in the upper sheath; panicles spikelike, solitary, 10-40 cm. long, 1-2 cm. thick, dense, sometimes lobed near the base; spikelets densely crowded, short-pedicellate, ascending along the short erect branches of the panicle. Spikelets lanceolate, acuminate; 3.5-5.5 mm. long, scabrous on the nerves; first glume 1.0-1.7 mm. long, ovate, 3-nerved, sometimes caudate; second glume 5-nerved, 2.8-3.9 mm. long, caudate; sterile lemma 5-nerved, longer than the second glume, caudate, 3.6-4.6 mm. long, lacking palea or flower; fertile lemma shorter than the sterile lemma, 2.5-3.5 mm. long; anthers 3, 1.1-1.2 mm. long, yellowish or pinkish; caryopsis elliptical, tan, free from the floret. Chromosome number $n = 10$ from Costa Rican material.

Marshes, ditches, lakes, riverbanks; occasional at low elevations from 20-850 m., mostly under 300 m., on both Caribbean and Pacific slopes. Apparently blooming yearlong. Southern Mexico to Argentina.

Hymenachne donacifolia (Raddi) Chase, J. Wash. Acad. Sci. 13:177. 1923. *Panicum donacifolium* Raddi, Agrost. Bras. 44:1823.

Succulent perennial; culms 3-4 m. tall, from long decumbent rooting bases, unbranched above, 4-6 mm. thick, glabrous, solid, the interior filled with stellate aerenchyma; nodes with swollen sheath pulvini; sheaths shorter than the internodes, glabrous, the margin somewhat pustulose-ciliate; ligule a minute membrane, ca. 0.4-0.5 mm. long; blades 25-27 cm. long, 27-40 mm. wide, glabrous, with cordate-clasping basal lobes, the margins scabrous. Peduncle included; panicles narrowly cylindrical, tapering to a narrow tip, the branches ascending, strict, the lower ones as much as 6 cm. long, the rachis exposed between whorls of branches. Spikelets short-pedicellate, densely clustered along the lower sides of the branches, 2.5-2.9 mm. long, lanceolate; first glume ovate, acute, 1-nerved, 0.9-1.1 mm. long; second glume 2.0-2.1 mm. long, lanceolate,



FIG. 94. *Hymenachne amplexicaulis*. Blooming plant, rooting culm base.

acute, 3-nerved; sterile lemma 2.3-2.6 mm. long, lanceolate, acute, 3-nerved; fertile lemma 2.0-2.2 mm. long, narrowly ovate, obscurely nerved; palea about equal in length; anthers 3, 0.5 mm. long, purplish. The foliage has a deep green to olivaceous coloration. Chromosome number $n = 20$ from a Costa Rican specimen.

Rare; elevations below 800 m.; riverbanks. General Valley near San Isidro (*Skutch 3963*), near San Vito de Java (*Pohl & Davidse 11161*). Southern Costa Rica, Panama; Cuba and Trinidad; Bolivia to Argentina.

HYPARRHENIA Andersson in Stapf

Perennial caespitose grasses; inflorescence usually complex, of numerous individually pedunculate spathaceous partial inflorescences, each of a pair of nearly conjugate rames at the tip of a slender peduncle; rames, or some of them, having a basal pair of sessile awnless spikelets that are staminate or sterile, followed by 1 or more spikelet pairs, each consisting of 1 sessile, awned, perfect-flowered spikelet and 1 pedicellate, nearly awnless, usually staminate spikelet; rame terminating in a triad of 1 sessile spikelet and 2 pedicellate spikelets. Spikelets dorsally compressed; glumes equal, lanceolate, the first flat on the back, 7-9-nerved, its margins incurved over the edges of the second glume and slightly keeled and ciliolate near the bifid tip; second glume 3-nerved, bulging on the back; florets usually 2, shorter than the glumes and completely concealed by them; lower lemma thin, membranaceous, faintly nerved; upper lemma in staminate or sterile spikelets similar to the first; upper lemma in perfect-flowered spikelets very narrow, membranaceous, 2-lobed at the tip, scarcely wider than the broad flat base of the stout, twisted and geniculate exerted awn. Disarticulation usually above the basal pair of spikelets and at the tip of each internode of the flattened, ciliate rachis, the spikelet pairs or triads falling as units. (Panicoideae: Andropogoneae.)

Hyparrhenia is a large genus of more than 75 species, nearly all confined to tropical and subtropical Africa, with a few species, some introduced, in tropical and subtropical America. The genus is closely related to *Andropogon*, differing mostly in the rounded and incurved, not keeled, margins of the first glume, and in the presence of a basal pair of sessile, equal, and usually staminate or sterile spikelets.

KEY TO SPECIES OF *Hyparrhenia*

- 1a. Rames of each pair ascending, diverging at an acute angle from each other; spikelet pairs usually 5 or more per rame; common cultivated forage grass, widely escaping *H. rufa*
- 1b. Rames of each pair strongly reflexed away from each other; spikelet pairs or triads usually 1-2 per rame; rare; Boruca *H. bracteata*

***Hyparrhenia bracteata* (Willd.) Stapf in Prain, Fl. Trop. Africa 9:360. 1919. *Andropogon bracteatus* Willd., Sp. Pl. ed. 4. 914. 1806. Figure 95.**

Perennial, in dense tufts; plants up to 2.5 m. tall, caespitose; culms erect, unbranched except in the inflorescence, up to 5 mm. thick, solid or with a small lumen, glabrous or



FIG. 95. *Hyparrhenia bracteata*. A, compound inflorescence; B, a rame and its spatheole; C, triad of a sessile, perfect-flowered spikelet and two awnless, pedicellate staminate spikelets.

appressed-silky below the contracted nodes; basal leaf sheaths keeled, overlapping; sheaths appressed-hirsute; ligule a firm brown membrane, 1-3 mm. long, densely short-ciliate on the margin; leaf blades up to 5 mm. wide, the margins revolute, lower surface appressed-hirsute like the sheath, upper surface glabrous or puberulent; midrib wide, flat above. Inflorescence an elongate virgate mass, up to 50 cm. long, much branched with several orders of ascending branches, each with a bladeless spathe; ultimate inflorescences borne on slender, heavily papillose-hirsute peduncles, each subtended by a spatheole longer than the peduncle, which protrudes laterally from it; rames paired, reflexed at the tip of the peduncle, a dense tuft of elongated glassy hairs between them; one rame subsessile and with a pair of sessile awnless staminate spikelets at its base; rachis bearing an oblong bract just above the pair of staminate spikelets; disarticulation just above this bract, the remainder of the rame usually a triad of one sessile perfect-flowered awned spikelet, accompanied by 2 pedicellate awnless or awn-tipped staminate spikelets. Callus of the sessile spikelet slender, pointed, heavily bearded; pedicels thin and flat, heavily bearded on the margins, extremely oblique at their tips. Basal awnless spikelets 5.0-5.5 mm. long, lanceolate; first glume 7-nerved, its edges infolded, slightly keeled and ciliate near the tip; second glume 4.5-5.0 mm. long, 3-nerved; lower lemma membranaceous, 4.0-4.2 mm. long, firm, ciliate, 1-nerved; upper lemma 3.0-3.2 mm. long, ciliate; lodicules 2, ciliate; anthers 0-3, ca. 2 mm. long. Sessile spikelet of the terminal triad 5.5-6.5 mm. long, lanceolate; first glume ca. 7-nerved, grooved on both sides of the midrib, bifid at the tip, the teeth acute, keels ciliate near the tip; second glume convex, lanceolate, 3-nerved, awn-tipped; sterile lemma 3.5-4.5 mm. long, membranaceous, faintly nerved; fertile lemma scarcely wider than the flattened awn base; awn ca. 3 cm. long, geniculate, the 2 basal segments strongly twisted and hispid; anthers 3, yellow, 1.5 mm. long; stigmas purple. Pedicellate spikelets similar, ca. 4.5 mm. long; first glume with an awn up to 1.8 mm. long, lower lemma ca. 2.5 mm. long; upper lemma 3.5-4.0 mm. long; anthers 3, 2.0-3.0 mm. long. Second rame of the pair similar to the first, but lacking the basal pair of sessile spikelets. Occasionally, 1 rame may contain more spikelet pairs.

Dry hilly savannas, Boruca and Buenos Aires; elevation 380-480 m.; rare. December. Southern Mexico to Brazil and Paraguay. Tropical Africa. Willdenow cited a specimen from Cumaná, Venezuela, and credited the species to Humboldt and Bonpland; however, he indicated that the description was his own and that he had seen a dry specimen.

Hyparrhenia rufa (Nees) Stapf in Prain, Fl. Trop. Africa 9:304. 1919. *Trachypogon rufus* Nees, Agrost. Bras. 345. 1829. Figure 96.

Perennial; densely caespitose, forming large clumps with numerous innovations and elongate drooping basal leaves; culms mostly 1-2 m. tall, unbranched except in the inflorescence, internodes round, glabrous, solid or with a small lumen; nodes contracted, glabrous or slightly puberulent, a swelling just above the node; leaf sheaths shorter than the internodes, keeled near the apex, from glabrous to marginally papillose-hirsute above, rarely hirsute all over; ligule a firm brownish membrane, 1.0-2.5 mm. long; blades flat, narrow at the base, glabrous, or hirsute above, especially near the base; basal blades up to 70 cm. long, 7 mm. wide, the culm blades smaller. Inflorescence a large compound mass, up to 50 cm. long, open, composed of numerous axillary branches, the ultimate inflorescences being paired slender rames borne on slender weak hairy peduncles exserted from bladeless sheaths. One of the pair of rames subsessile at the tip of the



FIG. 96. *Hyparrhenia rufa*. A, compound inflorescence; B, a pair of awnless spikelets from the base of a rame; C, pair with sessile, awned spikelet and pedicellate awnless spikelet.

peduncle, the other on a short rachis, one or both with a pair of equal awnless spikelets at the base. Rames 1-4 cm. long, with up to 8 pairs of spikelets, the terminal segment of the rachis bearing one sessile spikelet and a pair of equal awnless pedicellate ones. Rachis internodes, pedicels, and spikelets heavily bearded with rusty colored ascending hairs; rachis disarticulating at the base of the internodes and the tips of the pedicels; internodes thin, flat, ca. 3 mm. long. Basal pair of spikelets usually awnless, subequal, 4.5-5.5 mm. long, lanceolate in outline; first and second glumes equal in length, the first flattened on the back, the edges inrolled but not keeled except near the ciliate bidentate tip; nerves 9-11; second glume 3-nerved, tapering to the tip; lower lemma empty, 1-3-nerved, hyaline, ciliate; upper lemma similar, enclosing a staminate flower with 2 lodicules and 3 yellow to reddish anthers, 2.5-3.0 mm. long. Succeeding pairs of spikelets dimorphic, the sessile spikelet with a conspicuous geniculate awn, the 2 basal segments twisted and appressed-hispid, the terminal segment thin and straight; pedicellate spikelet 3.7-5.5 mm. long, lacking an awn but similar in shape to the other. Sessile spikelet 3.7-4.5 mm. long, with an empty lower lemma, the upper lemma very narrow, membranaceous, 2-lobed at the apex, the wide flat awn arising between the lobes; lodicules 2, truncate; anthers 3, yellow or reddish, usually smaller than those of the basal pair; stigmas purple. Pedicellate spikelets sterile or with minute staminodes.

Abundant in open areas, pastures, and savannas; elevations up to 900 m.; widely cultivated for forage and freely escaping to the wild, becoming a dominant species in Guanacaste. The principal season of bloom is from late October to December, when the tall culms develop synchronously over large areas. During most of the rest of the year, the plants remain vegetative, producing much basal foliage but only scattered and somewhat dwarfed blooming culms. *Hyparrhenia rufa* is of African origin, but is now widespread in the American tropics; Mexico to Brazil. Common name: *Jaraquá*.

HYPOGYNIUM Nees

Caespitose perennial grasses; inflorescence a compound mass of numerous individually spathaceous racemes, each of few pairs of similar awnless spikelets; rachis internodes thin, disarticulating at the nodes; racemes terminating in a single staminate spikelet; subsessile spikelet of each pair pistillate, with 2 stigmas and 3 minute staminodes; pedicellate spikelet of each pair staminate, with 3 fertile anthers; spikelets dorsally compressed, lanceolate, awnless; glumes equal in length, coriaceous, completely concealing the 2 florets; first glume flattened on the back, the margins sharply inflexed over the edges of the convex second glume; lower floret consisting of a thin membranaceous lemma, shorter than the glumes, lacking flower or palea; upper floret similar, consisting of a membranaceous lemma containing a pair of truncate lodicules and a staminate flower.

A small genus of two species, one in tropical Africa and the other in the American tropics. The genus was formerly united with *Andropogon*, from which it differs in having both spikelets of the pair externally equal, awnless, and pedicellate, and also in the unisexual spikelets. (Panicoideae: Andropogoneae.)

Hypogynium virgatum (Desv.) Dandy, J. Bot. 69:54. 1931. *An-dropogon virgatus* Desv. in Hamil., Prodr. Pl. Ind. Occ. 9:1825. Figure 97.

Perennial, caespitose in large dense tufts; culms erect, 95-165 cm. tall, unbranched except in the inflorescence, up to 4 mm. thick, glabrous; internodes mostly solid, filled with parenchyma or with a small lumen; nodes dark, glabrous, slightly contracted; basal leaf sheaths keeled and longer than the internodes, glabrous, the basal blades up to 90 cm. long, 3 mm. wide, the upper leaves with sheaths shorter than the internodes and much smaller blades that are pilose on the upper surface near the ligule, erect and flat near the base, involute above; ligule an inverted U-shaped stiff membrane, less than 1 mm. long. Inflorescence an elongated ellipsoidal compound mass, terminal on the main culms or axillary from upper leaf nodes, in total 15-40 cm. long, up to 6 cm. thick, repeatedly branching, each branch and the individual racemes subtended by a bladeless sheath or spathe. Individual racemes solitary on a short peduncle which is enveloped by a spatheole that envelops the lower portion of the raceme; racemes 1.0-1.5 cm. long, usually of 5-6 internodes, each bearing a pair of spikelets; rachis slender, scabrous, disarticulating at the bases of the internodes, bearing a solitary terminal staminate spikelet at the tip. Pistillate spikelet of each pair 2.8-3.1 mm. long, subsessile, on a thickish pedicel ca. 0.2 mm. long; first glume 2-3-nerved, hispid on the angles above; second glume 3-5-nerved; florets similar, the lemmas ca. 2.0 mm. long, staminodes minute; stigmas large, plumose, purple. Staminate spikelet similar to the pistillate spikelet, borne on pedicel ca. 1 mm. long; anthers 3, yellow or reddish, 1.1-1.2 mm. long. Chromosome number $n = 10$ from a Costa Rican specimen.

Savannas at Buenos Aires; roadsides near San Isidro de El General. December to February. British Honduras and Guatemala; northeastern Nicaragua; Costa Rica to Argentina; West Indies.

The plants are reddish in all their parts. Harlan (Rhodora 58:138. 1956) has reported a chromosome number of $n = 15$ for a Brazilian specimen designated as *H. spathifolius*.

ICHNANTHUS Beauvois

REFERENCES: K. E. Rogers, A taxonomic study of the genus *Ichnanthus* (Gramineae), Section *Foveolata* Pilger, Unpubl. Ph.D. Diss., Univ. of Tennessee. University Microfilms 69-16, 528. vii + 187 pp. 1969. Michael Stieber, A revision of the genus *Ichnanthus* (Gramineae) based on the morphology and anatomy, Unpubl. Ph.D. Diss., Univ. of Maryland. University Microfilms 75-29, 136. 211 pp. 1975. A. S. Hitchcock, The North American species of *Ichnanthus*, Contr. U.S. Natl. Herb. 22:1-12. 1920.

Perennial, usually decumbent or creeping grasses; leaf blades flat, often ovate; ligule a membrane; panicles terminal and axillary. Spikelets usually paired and unequally pedicellate, more or less dorsally compressed, but the glumes keeled; disarticulation below the glumes; glumes and lower lemma membranaceous, strongly nerved, acute or acuminate; first glume shorter than the spikelet, 3-5-nerved; second glume and lower



FIG. 97. *Hypogynium virgatum*. A, compound inflorescence; B, rame with base enveloped in a spatheole; C, terminus of a rame with a single staminate spikelet; D, spikelet pair.

lemma subequal, acute or acuminate, as long as the spikelet, surpassing and mostly concealing the upper (fertile) floret; second glume 5-9-nerved; lower lemma similar, with a well-developed palea and often a staminate flower; upper floret cartilaginous or rigid, dorsally compressed, awnless, ovate or elliptical, smooth and shining; lemma with inrolled margins, bearing on its lower curved margins depressed scars or winglike appendages, these continued downward into a minute stipe (rachilla internode). These scars or wings are usually considered to be appendages of the rachilla internode, although they fall with the easily detached fertile floret. Palea flat, its margins covered by the inrolled edges of the lemma.

The genus is common in moister parts of tropical America, and occurs in western Africa and tropical Asia as well. The plants usually occur in forests or forest margins, at low or middle altitudes. *Ichnanthus* is only weakly differentiated from *Panicum*, the best mark of distinction being the scars or appendages of the upper (fertile) lemma. The plants are extremely variable, and two recent authors have estimated the number of species as 27 and over 100, respectively. Some species, in addition to their great morphological variation, exhibit several levels of polyploidy. Chromosomal abnormalities and aneuploidy are known as well. It is evident that the genus needs continued biosystematic study. Occasional plants of various species may have weirdly proliferated, greatly elongated spikelets with numerous sterile, overlapping bracts, the whole resembling a multi-flowered spikelet of a pooid or chloridoid grass. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Ichnanthus*

- 1a. Mature upper lemma, including basal stipe (rachilla) 2 mm. or less long; terminal panicles with lower branches more than 5 cm. long, usually rebranched; upper lemma usually rotated 90° within spikelets when mature *I. pallens*
- 1b. Mature upper lemma 2-3 mm. long; terminal panicles with branches less than 5 cm. long, mostly simple; upper lemma usually not rotated within mature spikelet . . 2
 - 2a. First glume narrowly triangular, 3-nerved, tapering gradually into a caudate tip, the length, including the awn, 6.5-9 × the folded width; peduncles very slender, arching, exserted up to 19 cm. *I. tenuis*
 - 2b. First glume ovate, 3-5-nerved, tapering abruptly to a cuspidate tip, length 3.2-4.7 × the folded width; peduncles stiff, usually exserted 3-6 cm.

I. nemorosus

Ichnanthus nemorosus (Swartz) Doell in Mart., Fl. Bras. 2 (2):289. 1877. *Panicum nemorosum* Swartz, Prodr. Pl. Ind. Occ. 22. 1788. For a detailed synonymy, see Stieber, l.c. Figure 98.

Duration indefinite, probably perennial; plants creeping, forming patches, the culms rooting at the lower nodes and branching freely below; internodes 1.5 mm. or less thick, hollow, glabrous or papillose-pilose in lines or overall; nodes mostly bearded; sheaths shorter than the internodes, more or less papillose-pilose, especially on the margin; ligule a short-ciliate membrane, 0.5-1.3 mm. long; leaf blades flat, asymmetric at the



FIG. 98. *Ichnanthus* species. *I. nemorosus*: A, flowering shoot; B, spikelet; *I. tenuis*: C, flowering shoot; D, spikelet.

sometimes subcordate base, mostly 2-7 cm. long, 7-12 mm. wide, usually ovate 3.5-7:1, more or less papillose-pilose to nearly glabrous. Terminal peduncle exerted 3-6 cm.; terminal panicle 3-5 cm. long, 1.5-3 cm. wide, open pyramidal, with few short branches; terminal panicle usually accompanied by a smaller axillary barely exerted one from the terminal sheath, and often a small axillary one from the sheath below. Spikelets paired, unequally pedicellate, few on one branch, appressed, green or purple, 3.0-4.5 mm. long, ovate; first glume 1.8-3.6 mm. long, 3- or rarely 5-nerved, acute or cuspidate, the length 3.2-4.7 $\times$ the folded width; second glume 2.8-4.2 mm. long, ovate, acute, 5-nerved, sometimes with scattered weak hairs near the margin; lower (sterile) lemma 2.8-3.5 mm. long, ovate, acute, 5-nerved, enclosing a membranaceous palea at least three-fourths as long and usually a staminate flower with 3 stamens; rare individuals may have a pistillate lower flower; upper (fertile) lemma 2.1-2.6 mm. long, elliptic, blunt, cartilaginous, its lower margins scarred, the scars continued downward as wings on the short stipelike rachilla; palea similar and equal in length, its edges covered with the inrolled margins of the lemma; lodicules 2, truncate; anthers 3, yellow, 1.2-1.5 mm. long.

Moist forests; 600-2,200 m. elevation; mountains from Guanacaste to the Panamanian Border. June to October. Southern Mexico to Argentina; West Indies. We have recorded several chromosome counts of $n = 20$ for this species, as well as an aneuploid count of $n = 27$, and have observed cases of abnormal meiosis as well. This species is weedy and displays a great deal of variation in leaf shape and pubescence.

Ichnanthus pallens (Swartz) Munro ex Benth., Fl. Hongk. 414. 1861. *Panicum pallens* Swartz, Prodr. Ind. Occ. 23:1788. *Ichnanthus axillaris* (Nees) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:334. 1917. *Panicum axillare* Nees, Agrost. Bras. 141. 1829. Figure 99.

Perennial, the plants mostly decumbent and creeping, or the culms ascending into brush and up to 2-3 m. long; lower nodes rooting; branching abundant; culms usually 1.0-1.5 mm. thick, the internodes hollow, thick-walled; sheaths mostly shorter than the internodes, usually glabrous but with pilose upper margins; ligule a ciliate membrane, 1-2 mm. long; leaf blades flat, thin, dark green, usually ovate 2.3:1-5:1, rarely to 9:1, asymmetric and subcordate at the base, usually glabrous or scabrid. Inflorescences 1-several from the terminal sheath, one larger and longer-pedunculate than the other; axillary panicles usually present from several upper sheaths; panicles usually 5-10 cm. long, ovoid, the longest branch 5-7 cm. long, often somewhat congested, the larger branches secondarily branched, rather densely flowered, the spikelets appressed to the branches. Spikelets keeled, slightly laterally compressed, glabrous or scabrous, 3-4 mm. long, disarticulating entire, but the upper floret very weakly attached and frequently separating; first glume usually at least three-fourths as long as the spikelet, 3-nerved, triangular 3-4:1 as folded, acuminate; second glume and lower (sterile) lemma subequal or the glume slightly longer; second glume 5-nerved, the lateral pairs remote from the midrib, acuminate; lower lemma similar, enclosing a palea at least three-fourths as long and often a staminate flower with 3 stamens; upper (fertile) floret shorter than the glumes and lower lemma, 1.5-2.2 mm. long, elliptical, blunt, lemma cartilaginous, glabrous, dorsally compressed, its margins inrolled over the edges of the palea of equal length; lower margins of lemma bearing depressed scarred areas, these extending downward to the stipelike attached rachilla internode; stamens 3, the anthers yellow,



FIG. 99. *Ichnanthus pallens*. A, stoloniferous base; B, young panicle; C, mature panicle; D, spikelet; E, fertile floret, showing scars on basal lemma margins.

0.8-1.0 mm. long. Fertile floret when mature often rotating 90° within the spikelet, its back visible from the side of the spikelet.

Common in moist forested areas from near sea level to about 1,500 m. elevation, most common at lower elevations; rain forest, forest margins, clearings, coffee and cacao plantations, usually in areas with some disturbance, on both Pacific and Caribbean slopes; rare in Guanacaste. Blooming mostly July to December. Central America to northern Argentina; West Indies.

This species is somewhat weedy. The plants are astonishingly diverse, but it appears quite impossible to select separable types. Chromosome numbers among our Costa Rican collections were $n = 10$, 20, 27, ca. 30, and 30; however, no clear correlation was seen between ploidy level and morphological type. The two counts of $n = 10$ were from plants collected near sea level, and the higher counts were from greater elevations.

Ichnananthus tenuis (Presl) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:334. 1917. *Oplismenus tenuis* Presl, Rel. Haenk. 319. 1830. See Stieber, l.c. for an extended synonymy. Figure 98.

Duration indefinite, possibly annual; plants creeping, the lower nodes rooting; culms 10-70 cm. long, branching freely; internodes very slender, elongated, hollow, glabrous or pubescent, especially in longitudinal stripes; nodes usually bearded; sheaths much shorter than the internodes; more or less papillose-pilose; ligule a short, thin membrane, long-ciliate, in total up to 1.5 mm. long; leaf blades flat, thin, ovate 3.5-7:1, asymmetrical at the subcordate base, mostly 2.5-5.0 cm. long, 6-13 mm. wide, the surfaces scabrous to heavily papillose-pilose. Peduncles very slender, arched, elongated, up to 19 cm. long, usually several from the terminal sheath, with others arising from the axils of most of the lower sheaths. Terminal inflorescence usually 2-7 cm. long, open, the branches usually solitary, ascending; spikelets mostly paired, unequally pedicellate, appressed along the usually simple branches. Spikelets 3.5-4.5 mm. long, disarticulating entire, narrowly ovate, acuminate; first glume 2.1-3.6 mm. long, 3-nerved, narrowly triangular, the length 6.5-9 × the folded width, caudate; second glume about as long as the spikelet, 3.2-4.2 mm. long, 5-nerved, ovate, caudate, often bearing scattered weak slender hairs near the upper margins; lower (sterile) lemma similar, 2.6-3.5 mm. long, 5-nerved, enclosing a membranaceous palea at least three-fourths as long, usually with a staminate flower; upper (fertile) lemma elliptical, blunt, cartilaginous, light-colored, 1.9-2.6 mm. long, its lower margins with depressed scars that continue downward as wings onto the stipelike rachilla internode; margins inrolled over a palea of equal length; anthers 3, yellow, 0.8-1.5 mm. long. Chromosome numbers $n = 10$, 20 from Costa Rican specimens.

Along trails and streams in forests, mostly at elevations up to 300 m., but occasionally to 1,100 m., on both Pacific and Caribbean slopes. October to March. Southern Mexico to Brazil. The plants are somewhat weedy. They are best recognized by the small leaves and slender, whiplike peduncles, and the caudate, pubescent spikelets.

IMPERATA Cyrillo

Rhizomatous perennials; inflorescence a dense cylindrical terminal panicle, the spikelets mostly concealed by long, silky hairs borne on the axis, branches, pedicels, and spikelets. Spikelets paired, alike, unequally pedicellate, disarticulating from the disklike apex of the pedicels; callus truncate, bearing a ring of numerous elongate silky hairs several times as long as the spikelets; spikelets narrowly ovoid in outline; glumes nearly equal or the first slightly shorter than the second, membranaceous, 3-7-nerved, narrowly triangular, bearing scattered long silky hairs; sterile lemma and fertile lemma much shorter than the glumes, hyaline and nerveless, their apices erose-jagged; stamen usually 1.

A small genus of about seven species of warm climate grasses of both eastern and western hemispheres, related to *Saccharum* and *Eriochrysis*. The plants are often regarded as weeds with little forage value. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Imperata*

- 1a. Inflorescence 25-50 cm. long; culms 1-2 m. tall, leafy, bearing elongated leaf blades; spikelets 2.9-3.5 mm. long *I. contracta*
- 1b. Inflorescence 6-15 cm. long; culms up to 80 cm. tall, the foliage mostly near the base, the blades of stem leaves small; spikelets 3.5-4.5 mm. long *I. brasiliensis*

Imperata brasiliensis Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 2:331. 1832. *I. caudata* Cyr. ex Chapm., Fl. S. U.S. ed. 2. 668. 1883.

Perennial from scaly, creeping rhizomes; culms unbranched, 1 mm. thick, glabrous, 25-75 cm. tall, the interior more or less filled with parenchyma; nodes more or less bearded with tufts of appressed elongated silky hairs; foliage mostly basal, the 2-3 stem leaf blades usually small and the uppermost one very reduced; sheaths glabrous, the basal ones breaking down into stiff fibers; ligule a ciliolate brown membrane, 0.3-1.0 mm. long; larger leaf blades 6-15 cm. long, 8-10 mm. wide, glabrous except for prominent silky marginal hairs at the base, a few scattered long hairs on the upper surface near the base. Peduncle slender, glabrous, exserted up to 20 cm.; inflorescence a solitary terminal panicle, densely silvery-silky, 6-15 cm. long, 1-2 cm. thick, cylindrical and little tapered; rachis, branches, and pedicels bearing elongated silky hairs; apex of pedicels dilated, disciform. Spikelets paired, equal, narrowly ovoid, 3.5-4.0 mm. long; callus truncate, bearing a ring of elongate silky white hairs up to 12 mm. long; first glume slightly shorter than the second, narrowly triangular, ciliolate at the tip, bearing elongated silky hairs on the back; nerves 3-5; second glume similar but 5-7-nerved; sterile lemma hyaline, nerveless, triangular, the margins erose-jagged; fertile lemma similar, 0.5-1.1 mm. long; anther single, 1.8-2.8 mm. long, orange.

Rare; Buenos Aires savanna; El Paraíso. An old Oersted specimen is stated to have come from Guanacaste, but bears no other locality data. February to April. Florida; West Indies; southern Mexico to Brazil.

Imperata contracta (H.B.K.) Hitchc., Rep. Missouri Bot. Gard.

4:146. 1893. *Saccharum contractum* H.B.K., Nov. Gen. & Sp. 1:182. 1816. Figure 100.

Tall, coarse, erect perennial, 1-2 m. tall, forming large colonies by abundant scaly creeping rhizomes; culms unbranched, hollow, glabrous, 1-2 mm. thick; lower sheaths without blades; sheaths mostly overlapping, glabrous, with prominent auricles; ligule a firm brown ciliate membrane, 0.5-1.5 mm. long; blades up to 70 cm. long, 5-11 mm. wide, widest at the middle, tapering to a narrow base; midrib wide, white; blades scabrous on the margins, glabrous on the surfaces or occasionally with a few long papillose-based hairs on the auricles and behind the ligule; uppermost leaf blade much reduced. Inflorescence a solitary terminal panicle, narrowly cylindrical, dense, 25-50 cm. long, tapering toward the apex, the numerous branches ascending, usually 5 cm. or less long; panicle densely silky because of the numerous long hairs of the branches and spikelets, white or purplish. Spikelets unequally pedicellate, the shorter pedicel of each pair ca. 0.5 mm. long, the longer ca. 1.5 mm.; rachis, branches, and pedicels scabrous and bearing scattered long silky hairs. Spikelets of each pair equal, narrowly ovoid, acute, 2.9-3.5 mm. long; callus truncate, bearing numerous silky hairs up to 12 mm. long; glumes nearly equal or the first slightly shorter, lanceolate or triangular, 3-nerved, sometimes scabrous, their backs bearing scattered silky hairs, the tips sometimes minutely ciliate; lower lemma sterile, a hyaline nerveless oblong scale 1.5-1.8 mm. long, its tip erose or lobed and bearing minute marginal spicules; fertile lemma similar, shorter, 0.7-1.1 mm. long; lodicules not seen; anther one, 1.6-2.0 mm. long; caryopsis ca. 0.7 mm. long, obovate-cylindrical, 2:1. Chromosome number $n = 10$ from Costa Rican material.

Beaches and open areas, roadsides, near the Pacific Coast; Moín; Puriscal; San José area; mostly under 500 m. elevation. Blooming apparently yearlong. Southern Mexico to Peru and Brazil; West Indies.

The plants are coarse and weedy, forming large colonies by rhizomatous spread; probably of little value for forage. Common name *Zacate talquesa*.

ISACHNE R. Brown

REFERENCE: A. S. Hitchcock, The North American species of *Isachne*. Contr. U.S. Natl. Herb. 22:115-122. Pl. 25-32. 1920.

Inflorescence a panicle; spikelets biconvex, 2-flowered; glumes subequal, shorter than the florets, 5-7-nerved, a definite internode between the 2 glumes; florets similar or somewhat dimorphic, the second slightly shorter than the first, both containing flowers; lower flower staminate or perfect, the upper pistillate in our species; disarticulation above or below the glumes; florets joined by a very short rachilla segment and falling together.

Although this genus is obviously panicoid in many features, the fact that both florets are well developed causes the spikelets to be more or less globose, rather than dorsally compressed as in most other panicoid genera. (Panicoideae: Paniceae.)

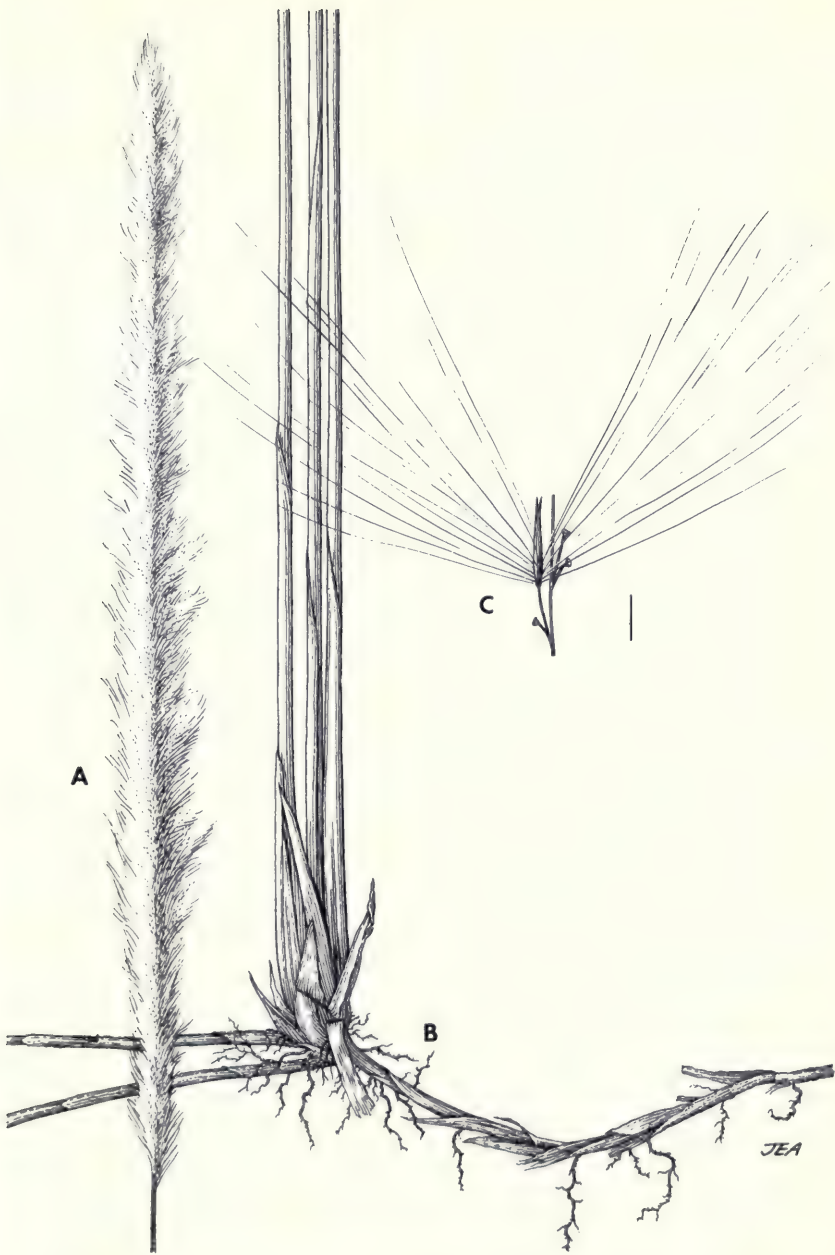


FIG. 100. *Imperata contracta*. A, inflorescence; B, rhizomatous plant base; C, portion of an inflorescence branch with unequal pedicels.

KEY TO SPECIES OF *Isachne*

- 1a. Low creeping plants; leaves cordate, 2-4 cm. long; upper floret puberulent
I. polygonoides
- 1b. Tall erect or scrambling plants; leaves not cordate, 9-20 cm. long; both florets glabrous *I. arundinacea*

Isachne arundinacea (Swartz) Griseb., Fl. Brit. W. Ind. 553. 1864.
Panicum arundinaceum Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Figure 101.

Perennial from hard, knotty crowns; culms hard, woody, scrambling, in brush or reclining on steep slopes and rooting from lower nodes, much branched, up to 5 m. long; main culms hard and woody, 4-8 mm. thick, thick-walled, glabrous, resembling bamboo canes; branches much thinner; young canes bearing nearly bladeless sheaths which are deciduous at maturity; sheaths of main culms shorter than the internodes, those of smaller lateral branches overlapping; sheaths usually glabrous except for the ciliate overlapping margin, rarely papillose-hispid; prophylla prominent, 2-3 cm. long; ligule of stiff white hairs, 0.5-3.5 mm. long; blades scabrous, rarely appressed-hispid below or on both surfaces, 9-20 cm. long, 7-22 mm. wide, rather firm; inflorescences mostly born on leafy branches from the elongated main culms; peduncle glabrous, 4-11 cm. long; panicles dome-shaped, nearly as wide as long when fully expanded, 8-12 cm. long, 8-11 cm. wide, the branches spreading, much branched above the middle, the spikelets crowded at the periphery of the panicle; spikelets obovoid to subspherical, scarcely compressed, 1.4-1.8 mm. long, disarticulating below the glumes, above the glumes, or the glumes dropping before the florets; glumes shorter than the spikelet, subequal, but the first somewhat narrower than the second, glabrous or with a few stiff hairs near the tips; first glume ovate, 5-nerved; 1.0-1.4 mm. long; second glume broadly ovate, 7-nerved, 1.0-1.7 mm. long; florets elliptical-obovoid, obscurely nerved; first floret 1.4-1.7 mm. long, the second 1.0-1.3 mm. long, on a very short rachilla segment; anthers 2-3, ca. 1 mm. long, yellow to purple. Chromosome number $n = 20$ from Costa Rican material.

Occasional; steep embankments, cliffs above streams, roadsides, forest margins; 30 to 1,900 m. elevation; more common on the Pacific slope, but also collected in the Limón area and at BriBri. Blooming yearlong. Southern Mexico to Peru; Caribbean Islands.

Isachne polygonoides (Lam.) Doell in Mart., Fl. Bras. 2:273. 1877.
Panicum polygonoides Lam., Encycl. 4:742. 1798. Figure 102.

Duration indefinite; total length of culms to 50-60 cm.; plants widely decumbent, the culms rooting at the lower nodes, the terminal portions erect; branching abundant; prophylla ca. 10 mm. long; culms hollow, soft, glabrous; nodes glabrous or papillose-pubescent; leaves numerous; sheaths shorter than the short internodes, papillose-ciliate on the overlapping margin, often papillose-hispid all over; ligule of rather sparse stiff hairs, 1-2.5 mm. long; leaf blades lanceolate, cordate-based, 2-4 cm. long, 7-13 mm. wide, thin, scabrous above and on the margins, papillose-ciliate at the base, sometimes to the tip, puberulent beneath; base of panicle included in the uppermost sheath; panicles terminal on leafy branches, 2-6 cm. long, pyramidal, the branches solitary, perpendicular to the rachis; branches and pedicels bearing yellowish glandular bands; spikelets biconvex, on stiff spreading pedicels; spikelets 1.3-2.0 mm. long, disarticulating below or above the glumes, the 2 florets remaining together; a definite internode between the first

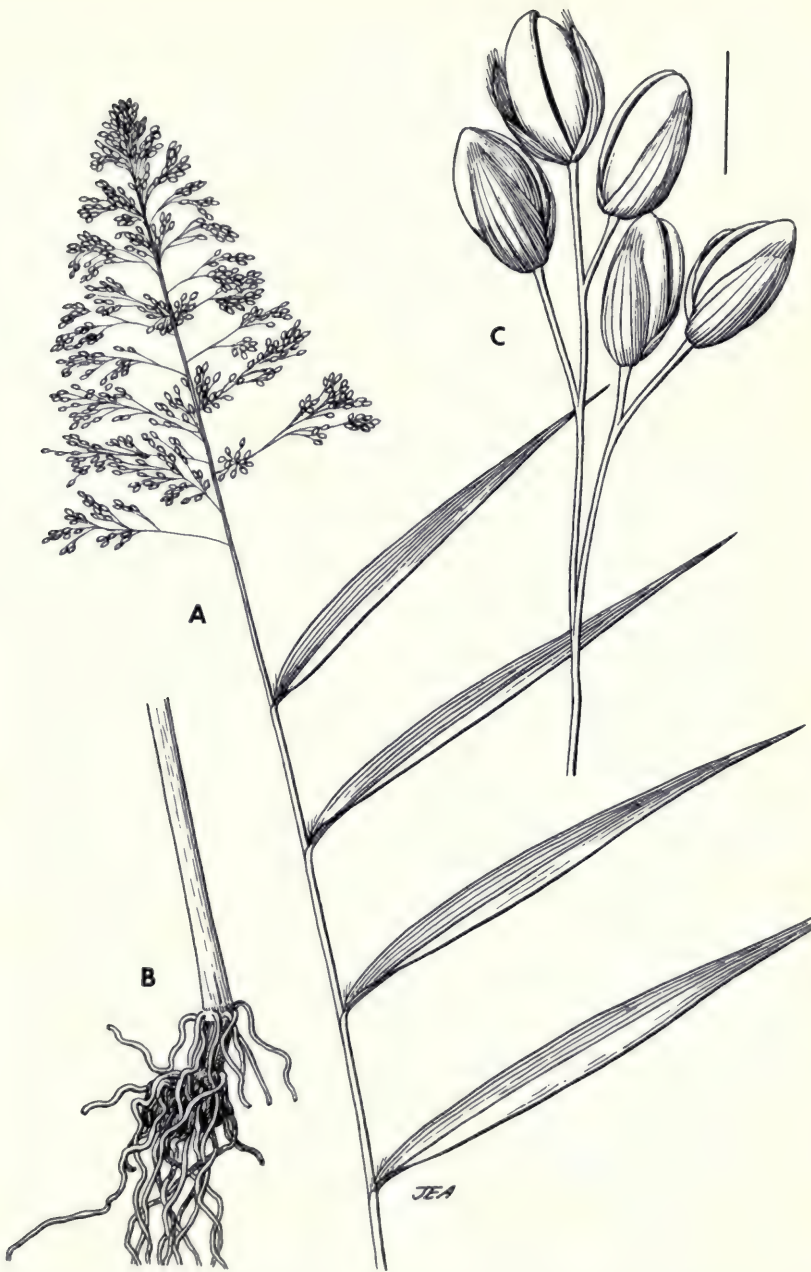


FIG. 101. *Isachne arundinacea*. A, flowering culm; B, base of plant; C, cluster of spikelets.



FIG. 102. *Isachne polygonoides*. A, panicle; B, spikelet, showing dimorphic florets.

and second glumes, the first glume 1.2-1.8 mm. long, 5-nerved, broadly ovate; second glume 1.3-1.9 mm. long, 7-nerved, broadly ovate; glumes glabrous or with a few stiff papillose hairs near the tips; lower floret with a glabrous, chartaceous lemma and palea; lemma 1.5-1.7 mm. long, oval, convex, faintly 5-nerved, the palea subequal, the flower staminate; anthers 3, 0.4-0.5 mm. long, yellow; upper floret with lemma 1.2-1.5 mm. long, hemispherical, puberulent, stiff, the palea plane, its margins narrowly overlapped by the lemma; flower pistillate, its truncate lodicules bearing abundant bicellular hairs. Chromosome number $n = 10$ from Costa Rican material.

Pond margins, ditches, swamps, often in shallow water; fairly common in Guanacaste; Tuis; Volcán; 270-400 m. elevation. September to February; possibly yearlong. Guatemala and Honduras to Peru and northern Brazil; West Indies.

ISCHAEMUM Linnaeus

Annual or perennial grasses; inflorescence of 2-many digitate racemes or rames borne at the apex of a terminal peduncle; individual rame or raceme composed of many internodes, each bearing 2 similar spikelets; disarticulation at the base of each internode, which falls with the 2 attached spikelets; one spikelet of each pair sessile or subsessile, the other pedicellate, the 2 similar, but the pedicellate one often somewhat smaller or reduced. First glume flattened, usually rigid and often cross-wrinkled below, thin and veiny above, its marginal flanges clasping the boat-shaped second glume of equal or slightly longer length; florets 2, concealed by the glumes; lower floret hyaline, awnless, with a staminate flower; upper floret shorter, the lemma hyaline, deeply bifid, the twisted awn arising at the juncture of the lobes; palea usually longer than the lemma. Pedicellate spikelet equal or smaller, often somewhat reduced and shorter-awned, in some species disarticulating from the pedicel.

The genus is unusual in the Andropogoneae in having a well-developed, staminate lower floret. About 50 species, almost all native to the Old World, a few of these occurring as weeds in the American tropics. (Panicoidae: Andropogoneae.)

KEY TO SPECIES OF *Ischaemum*

- 1a. Rames 2, closely appressed to each other, appearing as a single cylindrical spike; lower part of first glume of sessile spikelet strongly transversely corrugated
I. rugosum
- 1b. Racemes 2-many, spreading apart; first glume of subsessile spikelet stiff but smooth, not corrugated 2
 - 2a. Racemes 3-many; nodes and leaf blades glabrous; blades 10-33 mm. wide
I. latifolium
 - 2b. Racemes 2; nodes upwardly bearded; blades pubescent, less than 10 mm. wide *I. indicum*

Ischaemum indicum (Houtt.) Merrill, J. Arnold Arbor. 19:320. 1938. *Phleum indicum* Houtt., Nat. Hist. II: 13:198. t. 90, f. 2. 1782. *Ischaemum ciliare* Retz., Obs. Bot. 6:36. 1791. Figure 103.



FIG. 103. *Ischaemum* species. *I. latifolium*: A, inflorescence; *I. indicum*: B, portion of a raceme; *I. rugosum*: C, spikelet pair and rachis internode.

Duration indefinite; plants sprawling, the lower parts of the culms long decumbent and rooting at the lower nodes; upper portions of culms ascending, branching freely; prophylla 2.5-6 cm. long; internodes ca. 1 mm. thick, hollow, glabrous; nodes wide, dark, upwardly bearded; sheaths keeled, papillose-pilose on the margin and on the surfaces, especially toward the apex; ligule a thin, brownish membrane, 0.5-1.0 mm. long; leaf blades flat, 4-9 cm. long, 4-8 mm. wide, papillose-pilose on the surfaces, with a few stout hispid hairs at the base. Peduncles slender, glabrous, exserted 5-15 cm.; inflorescence a conjugate pair of diverging racemes, 6-8 cm. long. Spikelets paired at each node of the disarticulating rachis, one subsessile, on a pedicel ca. 0.5 mm. long, the other on a pedicel ca. 3 mm. long; rachis internode and pedicel similar, triangular in cross section, stiffly ciliate on the external angles. Disarticulation at the base of the internodes, the spikelet pair falling together with the internode. Subsessile spikelet biconvex, ovate 3:1, tapering to a short, narrow base; first glume ca. 4 mm. long, its basal third stiff, yellow, smooth, very broad, its marginal flanges covering the base of the second glume; upper two-thirds of the first glume thin, with many green nerves, most of them paired; apex bidentate; surface with numerous stiff spreading hairs; second glume longer than the first, bulging near the base, slightly winged near the tip, 5-nerved, tapering into a short straight awn; lower lemma ovate, acute, hyaline, ca. 3.5 mm. long, with a similar palea of about equal length; lodicules 2, truncate; stamens 3, the anthers yellow, 1.6-2.2 mm. long; pistil absent; upper floret perfect-flowered; lemma thin, hyaline, apex bifid to the middle, the awn arising between the teeth; basal segment of awn brown, tightly twisted, 3-4 mm. long; upper segment thin, only slightly twisted, purple, 6-7 mm. long; palea thin, hyaline, acute, longer than the lemma; lodicules 2, truncate; stamens 3, the anthers similar to those of the lower floret but longer; pistil with 2 separate naked style branches; stigmas purple. Pedicellate spikelet: Similar to the subsessile one, but usually smaller, the flower sometimes abortive. Chromosome number $n = 9$.

The only Costa Rican collection is the following: Puntarenas, Golfito; very common on sand along a stream, elevation 2 m., 11 December 1968, P. & D. 11571. Introduced from the Old World; reported from Panama and Guyana.

***Ischaemum latifolium* (Spreng.) Kunth, Rév. Gram. 1:168. 1829.**
Andropogon latifolius Spreng., Syst. Veg. 1:286. 1825. Figure 103.

Perennial; plants sprawling or erect, the culms 45-150 cm. long, sometimes rooting at the decumbent lower nodes, freely branching; internodes solid, pithy, glabrous; nodes wide, glabrous; sheaths glabrous except for the bearded collar, keeled toward the apex; ligule a brown membrane, 0.5-2.0 mm. long, tipped with cilia 0.5-2.0 mm. long; leaf blades flat, broad, 6-10 × longer than wide, 6-24 cm. long, 10-33 mm. wide, narrowed abruptly to the base, bearded on the collar and lower side at the base, otherwise glabrous. Peduncle slender, glabrous, exserted 3-10 cm.; uppermost leaf blade reduced; peduncle forking once or twice at the tip, the branches bearing a fan-shaped cluster of 5-17 racemes, each 6-12 cm. long. Spikelets paired, one subsessile, its pedicel ca. 0.3 mm. long, the other on a pedicel ca. 3 mm. long; rachis internodes and pedicels bearded on the angles and at the tip; disarticulation at the base of the internodes, the spikelet pair falling; sometimes the pedicellate spikelet disarticulates from its pedicel. Subsessile spikelet: 4.5-7.0 mm. long; first glume narrowly ovate, 4.5:1, acute, flat to convex on the back; margins slightly keeled and ciliate near the bifid tip; basal portion firm, smooth; upper portion herbaceous, 5-7-nerved, some of the nerves forking; second glume convex,

awn-tipped, slightly longer than the first; lower lemma nearly as long as the first glume, 4.0-5.5 mm. long, hyaline, acute, ciliate above, its palea slightly shorter; lodicules 2, truncate; anthers 3; upper floret with a hyaline, bifid lemma 3.5-4.0 mm. long, bearing an awn 5.0-9.5 mm. long from the sinus; palea about as long as the lemma; lodicules 2, truncate; anthers 3, yellow, 2.1-2.3 mm. long; caryopsis 1.5 mm. long, clear amber, with a large embryo. Pedicellate spikelet: Similar to the sessile one, but becoming laterally compressed by the folding of the first glume along one keel, the other scarcely developed; florets similar to those of the sessile spikelet, but somewhat red-iced and the fertile lemma shorter-awned.

Brushy roadside, Canton de Dota, 1,400-1,800 m.; Buenos Aires; stream banks, northern Guanacaste. September to February. Mexico to Ecuador and Brazil. Chromosome number $n = 18$ from a Costa Rican specimen (*P. & D. 11067*) that is smaller and has narrower blades than most specimens of this species.

Ischaemum rugosum Salisb., *Icon. Stirp. Rar.* 1, pl. 1. 1791. Figure 103.

Caespitose annual; culms 55-130 cm. tall, erect or the bases decumbent and rooting; branching freely from most nodes; prophylla prominent, 4-8 cm. long, with several accessory nerves on each lateral flange; culms 2-3 mm. thick, hollow, glabrous; nodes wide, dark, bearded at the lower margin with a circle of appressed, ascending, silky, white hairs; sheaths shorter than the internodes, glabrous except on the margin below the apex, slightly keeled above; ligule a thin brown membrane, 2.0-5.5 mm. long, adnate to the erect sheath auricles; leaf blades flat, 8-20 cm. long, 7-15 mm. wide, softly papillose-pilose on both surfaces; base of blade usually contracted into a short, woolly pseudopetiole. Peduncle glabrous, erect, exserted 3-11 cm.; inflorescences several, borne on the culm apex and from the upper leaf axils, consisting of a pair of conjugate rames, closely appressed to each other and appearing as single cylindrical spike ca. 5 mm. in diameter, 3-10 cm. long, the 2 rames at maturity somewhat spreading apart near the apex. Spikelets paired, one sessile and one pedicellate at each node; rachis internodes thick, 2.8-3.5 mm. long, triangular in cross section, the external faces yellowish, rigid, the inner side hyaline, thin, the interior hollow; external angle of the surface with a line of stiff appressed hairs; base of the internode and callus of the sessile spikelet bearded with short ascending hairs; pedicel similar to the rachis internode, usually shorter, 1.5-2.5 mm. long; rames disarticulating freely at the base of each internode, the rachis internode, pedicel, and the 2 spikelets falling as a unit. Sessile spikelet: First glume 3.8-5.0 mm. long, ovate, acute, 2.5:1, slightly convex, the lower three-fifths rigid, yellowish, very strongly transversely corrugated, the upper two-fifths flat, herbaceous, longitudinally striate with many fine green nerves; margins of the glume bearing 2 inflexed flanges that clasp the margins of the second glume; second glume keeled, boat-shaped, slightly longer than the first, acute; lower lemma thin, ovate, acute, faintly nerved, awnless, its palea a hyaline nerveless scale, shorter than the lemma; stamens 3, the anthers 1.5-1.8 mm. long, pink; pistil rarely present; upper floret perfect-flowered or pistillate, its lemma hyaline, 3-4 mm. long, bifid to the middle, the awn attached on the outer side at the junction of the acuminate teeth; awn 1.5-2.0 cm. long, bent, the basal half brown, strongly twisted, the upper segment thin, white, loosely twisted; palea hyaline, nerveless, shorter than the lemma. Pedicellate spikelet: Similar to the sessile

spikelet but smaller, the first glume asymmetric, ovate 2:1, the lower half yellow, rigid, sometimes slightly undulate, the upper portion green, herbaceous, finely striate; flower usually staminate. Chromosome number $n = 9$ from Costa Rican specimens. A base number of $x = 10$ is also reported for this genus.

Occasional but locally abundant; *Curatella-Byrsonima* savannas in northern Guanacaste, in road ditches, pastures, sometimes in shallow water; sea level to 600 m. elevation; also collected at Los Angeles (Río Peñas Blancas), Chomes, and Turrialba. This Old World species is apparently a recent introduction in Costa Rica, the earliest collection dating to 1950. Panama, Venezuela, Trinidad, Cuba, and Jamaica.

IXOPHORUS Schlechtendal

Caespitose perennial; inflorescence a panicle with simple spreading or ascending branches racemously arranged along the rachis; spikelets subsessile in 2 rows along the lower sides of the triquetrous branches; each spikelet subtended by a single bristle longer than the spikelet; disarticulation below the glumes. Spikelets dorsally compressed; first glume much shorter than the spikelet, 3-nerved; second glume and sterile lemma subequal, as long as the spikelet and concealing the fertile floret; second glume many-nerved; lower lemma 5-nerved, containing 3 stamens; palea 2-keeled, as long as the lemma or slightly longer, at full maturity of the fruit becoming circular with a cordate base and broad chartaceous wings, much wider than the remainder of the spikelet; upper floret shorter than the spikelet, elliptical, the lemma indurate, apiculate, with margins inrolled over the edges of the indurate palea; flower of upper floret pistillate, rarely with rudimentary stamens.

Ixophorus is similar to *Setaria* in possessing sterile branches (bristles) in the inflorescence, but differs in the winged spikelets. (Panicoideae: Paniceae.)

Ixophorus unisetus (Presl) Schlecht., Linnaea 31:421. 1861-62.
Urochloa uniseta Presl, Rel. Haenk. 1:319. 1830. Figure 104.

Coarse caespitose perennial; culms 50-140 cm. tall, up to 1 cm. thick, rather succulent, erect, unbranched; sheaths mostly overlapping, somewhat keeled, glabrous; nodes glabrous or slightly appressed-pubescent; ligule a lacerate or ciliate membrane, 1.0-2.5 mm. long; blades lax, with a conspicuous white midrib, glabrous, 10-25 mm. wide, up to 75 cm. long; panicles 10-25 cm. long, ovoid-cylindrical, of numerous racemously arranged simple racemes, the lower ones 2-8 cm. long, the upper successively shorter, often naked near the base; spikelets dorsally compressed, 3.5-4.7 mm. long, each subtended by a scabrid purple bristle (sterile branch), 1-2 × as long as the spikelet; outline of young spikelets lanceolate; first glume broadly ovate, acute, 3-nerved, 0.7-1.5 mm. long; second glume many-nerved; lower lemma 5-nerved; palea of lower lemma at maturity becoming circular, with a cordate-auriculate base, expanding the spikelet to circular outline; stamens 3, 2-3 mm. long; upper lemma indurate, papillose, brownish. Chromosome number approximately $n = 31-33$ from Costa Rican material. Other counts of $n = 17$ are known.

Sea level to 1,200 m. elevation; common in Guanacaste, San José area, Limón area, Turrialba, Siquirres, Palmar Norte. Mexico to

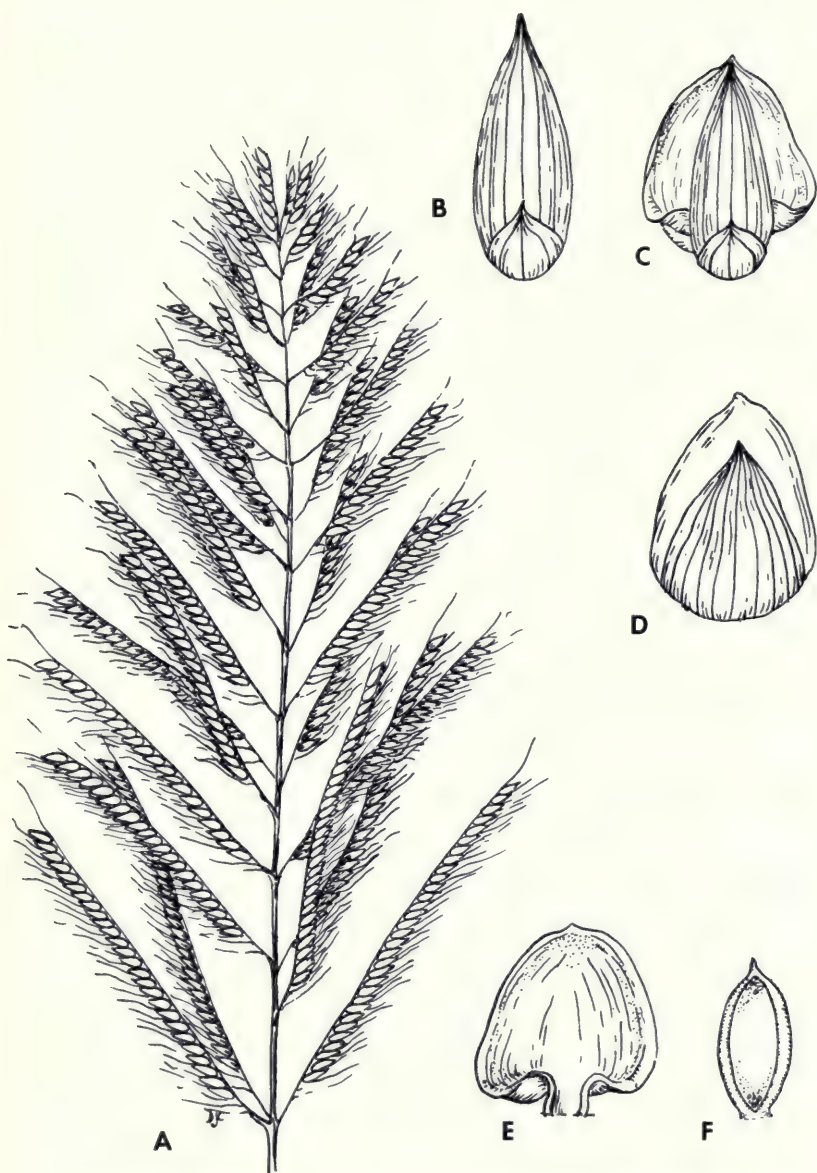


FIG. 104. *Ixophorus unisetus*. A, panicle; B, young spikelet; C, mature spikelet with winged palea of the lower floret; D, mature spikelet from second glume side, showing winged palea of lower floret; E, winged palea of lower floret, F, upper (pistillate) floret.

Costa Rica; Colombia and Venezuela; Cuba. This species is used for forage production under the names *Zacate de Honduras* and *Zacate blanco*.

JOUVEA Fournier

Stoloniferous, pungent-leaved perennial maritime grasses of coastal dunes and mud flats; dioecious, the staminate and pistillate inflorescences very different. Staminate plants: Inflorescences clustered from upper few leaf axils, 1-3 peduncles arising in each axil, forming a cylindrical or flabellate group; individual inflorescence a spike on a slender, short-exserted peduncle. Spikelets sessile, many-flowered; first glume absent or a minute scale; second glume 1-nerved, shorter than the first floret; lemmas faintly 3-nerved; palea nearly as long as the lemma, 2-keeled; rachilla not disarticulating; anthers 3; lodicules 2, truncate, vasculated. Pistillate plants: Pistillate inflorescence a cluster of stiff, sharp-pointed hornlike bodies, subtended closely by foliage leaves, the horns interspersed with prominent prophylls; individual horns falcate, cylindrical, hard, acerose-pointed, containing several pistils in alternating succession, each sealed within a linear cavity in the spongy interior of the horn, the style emerging through a small apical ostiole; caryopsis linear, naked within the cavity or accompanied by a small nerveless scale.

The horns have been interpreted as spikelets by Weatherwax (Bull. Torrey Club 66:315-325. 1939), but their structure and their aggregation into prophyllate clusters are so unusual as to make the homology dubious.

Jouvea is a genus of only two species, ranging from Baja California to Panama. Because of the highly unusual structures of the female inflorescences, the relationship of the genus to others is obscure. Leaf anatomy and chromosome size and number indicate that it is Chloridoid. (Chloridoideae: Aeluropodeae.)

KEY TO SPECIES OF *Jouvea*

- 1a. Plants of sand dunes on open beaches, forming dense, leafy mounds; stolons thick and stiff (often becoming buried in the sand), usually with an erect branch at each node; their internodes usually 2-6 cm. long, leaf sheaths covering one-third or more of their length; leaf blades persistent *J. pilosa*
- 1b. Plants of saline mud flats behind the beaches or in estuaries, forming sparse flat mats on surface of soil; stolons thin and wiry, not becoming buried; their internodes usually 6-10 cm. long, leaf sheaths usually less than one-third as long as internodes, the leaf blades usually deciduous from the sheath *J. straminea*

Jouvea pilosa (Presl) Scribn., Bull. Torrey Bot. Club 23:143. 1896.
Brizopyrum pilosum Presl, Rel. Haenk. 1:280. 1830.

Plants forming mats or mounds on sandy beaches; strongly stoloniferous, the stolons often buried in sand, profusely branching; flowering on branches or raised tips of the stolons; culms hollow, glabrous, strongly ridged; nodes yellowish, smooth; leaf sheaths keeled, shorter or longer than the internodes, 1-3 cm. long, glabrous except for a cluster



FIG. 105. *Jouvea straminea*. A, staminate plant with inflorescence; B, pistillate inflorescence; C, pistillate horn with emergent stigmas.

of tuberculate-based auricular hairs; prophylls prominent, 2-keeled, up to 2 cm. long; ligules membranous, crowned with a dense fringe of white cilia, less than 1 mm. long; leaf blades stiff, often folded, 5-15 cm. long, or much shorter in the female inflorescence, 2-4 mm. wide, glabrous beneath, with scattered long hairs above, the upper surface strongly ridged. Staminate inflorescence: Spikes 1-several, terminal and axillary from upper sheaths; peduncle included or slightly exerted; groups of spikes forming a cylindrical cluster; individual spikes 5-7 cm. long, oblong, the spikelets borne alternately in 2 rows on 2 sides of a triquetrous rachis. Spikelets overlapping, often proliferous and with up to 30 florets, 1.5-4.0 cm. long; first glume absent or a minute scale less than 1 mm. long; second glume 3.5-4.0 mm. long, 1-nerved, keeled, lance-linear; rachilla persistent, the florets not disarticulating; lemmas with prominent midrib and several faint lateral nerves, ovate, keeled, 3.5-4.5 mm. long, acute, glabrous; palea as long as or slightly longer than the lemma, prominent, scabrid on the keels; anthers 3, 2.5 mm. long, purplish; lodicules 2, truncate, lacerate, vasculated. Spikelets continue to produce new florets at the tip after flowering has ceased in the lower ones. Pistillate inflorescence: a dense, flabellate cluster of stiff, sharp-pointed hornlike bodies, these subtended by short, stiff leaf blades and interspersed with prominent prophylls; individual horns falcate, cylindrical, 2-4 cm. long, acerose-pointed, containing usually 2-5 caryopses, each sealed within a cylindrical cavity in the spongy interior of the horn, the style emerging through a small apical ostiole; caryopsis linear, tan, filling the cavity of the horn, naked or rarely accompanied by a small nerveless bract. Chromosome number $n = 10$ from Costa Rican material.

Pacific beaches of Guanacaste, on low sand dunes; Playa Tamarindo, Playa Naranjo in Parque Nacional de Santa Rosa, Puerto Soley. Probably blooming yearlong. Pacific beaches; Mexico, Guatemala, El Salvador, Honduras, and Costa Rica.

Jouvea straminea Fourn., Bull. Soc. Roy. Bot. Belgique 15:475. 1876. Figure 105.

Plants caespitose in dense, hard tufts; the culms arising from prophyllate bases, reclining, forming extensive flat open mats on dry mud flats; stolons numerous, thin and wiry, sparsely branched, up to 150 cm. long; culms arising in small clumps from the stolons, glabrous, the nodes dark-colored; leaf sheaths 0.5-2.0 cm. long, usually less than one-third as long as the internodes, glabrous except at the auricles, not keeled; ligules 0.5-1.0 mm. long, ciliate; leaf blades 1.5-5.0 cm. long, 2-3 mm. wide, often folded, tending to disarticulate from the sheaths on stolons. Staminate inflorescence: A cluster of several terminal or axillary spikes from the apex of the culms and the upper nodes, the peduncles mostly included; individual spikes 2-4 cm. long, slender. Staminate spikelets usually 2-4, appressed along 2 sides of a thin triquetrous rachis, strongly laterally compressed and keeled, 1-4 cm. long, proliferous, the rachilla producing new florets at the tip after the lower ones have shed their pollen; first glume usually absent or up to 5 mm. long and 1-nerved, acicular; second glume lance-linear, 1-nerved, sometimes with an additional weak lateral nerve, 4-6 mm. long, stiff, scabrid on the keel; florets up to 30, not disarticulating; lemmas 3.5-4.0 mm. long, narrowly ovate, acute, glabrous, 3-nerved, rarely with additional faint nerves, awnless; palea about as long as the lemma, scabrid-ciliate on the keels; flower staminate; stamens 3, the anthers ca. 2.5 mm. long, yellowish or purplish; lodicules 2, truncate, fleshy, prominently vasculated. Pistillate inflorescence: Plants bearing at the upper several nodes of the culms axillary and terminal clusters of

several rigid hornlike cylindrical bodies, their bases concealed by the subtending leaf sheath and several papery prophylls; horns 1.5-3.0 cm. long, ca. 1.5 mm. thick, curved, rigid, tapering to a pointed base and apex, readily disarticulating at the base; pistillate flowers 2-3, concealed within the horn by an adnate narrowly triangular flap of tissue, the single flattened style emerging through a small apical ostiole; stigmas 2, not strongly plumose; ovary naked or accompanied by a narrow hyaline bract. Chromosome number $n = 10$ from Costa Rican material.

Drying mud flats behind beaches and in estuaries, Pacific Coast of Guanacaste, Puerto Castillo, Puerto Soley, Playa Naranjo in Parque Nacional de Santa Rosa. Blooming sparsely in December and January; staminate plants only seen in Costa Rica. Mexico to Panama, on the Pacific beaches.

LASIIACIS (Grisebach) Hitchcock

REFERENCE: G. Davidse, A systematic study of the genus *Lasiacis* (Gramineae: Panicoideae), Unpubl. Ph.D. Diss., Iowa State Univ. Library. 231 pp. 1972.

Perennial, erect, scandent, or prostrate grasses; caespitose or creeping; culms much-branched, often thick and semi-woody; internodes solid or hollow; ligules membranaceous; leaf blades linear to ovate, sometimes borne on a short pseudopetiole. Inflorescence an open or contracted panicle, terminal on the culm or on leafy branches. Spikelets subglobose to globose, ovate, or elliptic, placed obliquely on the pedicel, disarticulating entire; glumes and lower (sterile) lemma broad, abruptly apiculate, many-nerved, membranaceous, but becoming black and shiny at maturity, woolly at the apex; first glume one- to two-thirds as long as the spikelet, 5-13-nerved, its lower margins overlapping; second glume and sterile lemma subequal, ca. as long as the spikelet, 7-15-nerved; lower (sterile) lemma enclosing a palea one-fourth as long to equalling the lemma; staminate flower present or absent; fertile lemma hard, rigid, obtuse, its margins inrolled and enclosing the edges of a similar palea; floret usually dark brown when mature, broadly elliptic to obovate; palea convex above, concave near the base; both lemma and palea with a tuft of wool at the tip; stamens 3; styles 2, separate; lodicules 2, fleshy, truncate, vasculated.

Lasiacis is a genus of 16 species of grasses native to tropical and subtropical parts of North and South America and the West Indies. The plants are distinguished from all other panicoid grasses by their rotund black spikelets, set obliquely on the pedicel and woolly-tufted at the tip. Individuals of most of the species are large, somewhat woody plants, vaguely resembling small bamboos or *Olyra latifolia*. They are abundant in somewhat disturbed sites on roadsides, in brush, or on the margins of forests. Recent studies by Davidse have shown that the mature, black spikelets store oil droplets in the inner linings of the bracts. They are consumed by fruit-eating birds, who obtain nutrition from this oil, rather than from the heavily protected and undi-

gested grain. This peculiarity of the spikelets, which immediately sets the genus off from all other grasses, undoubtedly accounts for the abundance of the plants on the forest margins where birds frequently perch. The genus is most closely related to *Acroceras*. (Panicoideae: Paniceae.) It is commonly called *carrizo*.

KEY TO SPECIES OF *Lasiacis*

- 1a. Culms solid, pithy; plants sprawling or creeping and rooting at lower nodes . . 2
- 1b. Culms hollow or mostly so; plants creeping, ascending, or clambering on brush or trees 5
 - 2a. Ligules 1.4 mm. or less long 4
 - 2b. Ligules 2.0-6.0 mm. long; leaf blades linear-lanceolate, 13-29 cm. long ... 3
- 3a. Sheaths glabrous; spikelets paired or clustered near ends of panicle branches; lower floret staminate, with long palea *L. oaxacensis* var. *oaxacensis*
- 3b. Sheaths puberulent or pubescent; spikelets solitary on long pedicels; lower floret sterile, its palea two-thirds or less as long as lemma *L. linearis*
 - 4a. Foliage glabrous; blades 16-25 cm. long; lower floret staminate
L. oaxacensis var. *mazonii*
 - 4b. Foliage pubescent; blades 8-17 cm. long; lower floret sterile
L. rhizophora
- 5a. Plants creeping and rooting at the lower nodes; ligules 4.5-9.0 mm. long; palea of lower floret less than half as long as lemma *L. standleyi*
- 5b. Plants erect or scrambling; culms hollow 6
 - 6a. Leaf blades conspicuously cordate-based, clasping stem, 14-42 cm. long; lower nodes decumbent, producing conspicuous thick wiry prop roots; panicles very large, 20-120 cm. long, very open and dome-shaped *L. procerrima*
 - 6b. Blades not conspicuously cordate-based, smaller; plants without prop roots; panicles less than 30 cm. long, mostly compactly flowered 7
- 7a. Ligules of upper leaves readily visible, usually 2-7 mm. long 8
- 7b. Ligules of upper leaves not readily visible, usually less than 1.5 mm. long 9
 - 8a. Ligules mostly 4-6 mm. long; panicle spherical, less than 9 cm. long; upper leaf surface scabrous *L. scabrior*
 - 8b. Ligules mostly less than 3.5 mm. long; panicles large, ovoid, 9-30 cm. long; upper surfaces of blades glabrous or pubescent
L. sorghoidea var. *sorghoidea*
- 9a. Leaf blades glabrous on both surfaces 10
- 9b. Leaf blades with some pubescence on at least one surface 14
 - 10a. Blades linear to narrowly lanceolate, 7-11 × longer than wide, usually less than 2 cm. wide 11
 - 10b. Leaf blades broadly lanceolate to ovate, 3-6 × longer than wide, more than 2 cm. wide 13
- 11a. Panicles few-flowered, branches spreading or reflexed; mature pedicels sharply divergent; culms zigzag *L. divaricata* var. *divaricata*
- 11b. Panicle branches not reflexed; culms straight or zigzag 12
 - 12a. Base of panicle included in uppermost sheath; pedicels and branches short
L. divaricata var. *leptostachya*

- 12b. Base of panicle usually exerted; pedicels slender, widely spreading, flexuous *L. nigra*
- 13a. Main inflorescence branches sparsely branched, bearing few spikelets; pedicels appressed, short; blades with short, puberulent pseudopetioles *L. sloanei*
- 13b. Main inflorescence branches much branched; pedicels not appressed; leaf blades lacking a distinct pseudopetiole *L. ruscifolia* var. *ruscifolia*
- 14a. Leaf blades lanceolate, 6-11 × longer than wide 15
- 14b. Leaf blades ovate, 3-6 × longer than wide 16
- 15a. Panicles 5-12 cm. long; pedicels spreading; spikelets 4.0-5.0 mm. long . *L. nigra*
- 15b. Panicles 9-25 cm. long; pedicels not spreading; spikelets 3.4-4.1 mm. long
L. sorghoidea var. *sorghoidea*
- 16a. Blades 6-14 cm. long, 18-44 mm. wide *L. ruscifolia* var. *ruscifolia*
- 16b. Blades 4-7 cm. long, 8-15 mm. wide *L. rugelii* var. *pohlii*

***Lasiacis divaricata* (L.) Hitchc., Contr. U.S. Natl. Herb. 15:16. 1910, var. *divaricata*. *Panicum divaricatum* L., Syst. Nat. ed. 10. 2:871. 1759.**

Robust perennial; caespitose; culms erect or arching and clambering in brush, up to 7 m. long, the upper portions of the culms and main branches usually zigzag; internodes hollow, 5-9 mm. thick, glabrous or puberulent; nodes glabrous; sheaths glabrous or puberulent, ciliate on the margin; auricular hairs up to 3 mm. long; ligule inconspicuous, usually less than 0.6 mm. long, ciliate or glabrous; leaf blades usually 5-12 cm. long, 6-14 mm. wide, linear or narrowly lanceolate, glabrous, scabrous, or puberulent. Inflorescence usually 2-12 cm. long, the longest branch 2-8 cm. long; branches spreading or reflexed; pedicels strongly divergent. Spikelets obovate, 3.5-4.5 mm. long; first glume 1.2-2.5 mm. long, 7-11-nerved; second glume 9-11-nerved; lower (sterile) lemma lacking a flower, 9-13-nerved, its palea half or more as long; upper (fertile) lemma 3.4-4.0 mm. long, whitish to brown; anthers white, ca. 2 mm. long; stigmas purple; caryopsis 2.2-2.4 mm. long, whitish. Chromosome number $n = 18$.

Caribbean lowlands, in brushy margins of forests. Southern Florida; West Indies and northern South America; Mexico to Panama. Usually fruiting from June to March.

Var. *leptostachya* (Hitchc.) Davidse, Ann. Missouri Bot. Gard. 64:375. 1977. *Lasiacis leptostachya* Hitchc., Contr. U.S. Natl. Herb. 22:19. 1920.

This variety differs from the typical var. *divaricata* in its narrower leaf blades, occasionally heavily pubescent culm internodes, somewhat larger spikelets, and smaller, denser panicles which are included at the base and lacking divaricate branches except at full maturity.

Northwestern Costa Rica. Oaxaca and Veracruz to Panama.

***Lasiacis linearis* Swallen, Phytologia 4:427. 1953.**

Creeping perennial; the culms solid, 2-5 mm. thick, the lower nodes decumbent and rooting, the terminal portions erect, up to 100 cm. long, freely branching, forming large tangled colonies; internodes glabrous or with a line of pubescence; nodes glabrous;

sheaths puberulent or pubescent, the overlapping margin ciliate; ligules tan to dark brown, ciliate, 1.4-4.8 mm. long, conspicuous; leaf blades linear, asymmetric at the base, 13-22 cm. long, 8-18 mm. wide, glabrous, scabrid, or puberulent. Inflorescence 19-30 cm. long, the branches spreading, up to 23 cm. long, naked on the lower half, the long-pedicellate spikelets borne toward the tips. Spikelets narrow, obovate, 3.9-4.5 mm. long; first glume 2.0-2.5 mm. long, 7-9-nerved; second glume 8-11-nerved; lower (sterile) lemma empty, 9-11-nerved, its palea one- to two-thirds as long as the lemma or rarely absent; upper (fertile) lemma 3.9-4.1 mm. long; anthers white; stigmas purple; caryopsis 2.2-2.4 mm. long. Chromosome number $n = 18$.

Cloud forests, oak and pine forests, forest margins, elevation 1,400-2,400 m. San Gabriel. June through March. Southern Mexico to Northern Panama.

***Lasiacis nigra* Davidse, Phytologia 29:152. 1974. Figure 106.**

Caespitose perennial; culms erect at the base, arching above and clambering into vegetation, up to 12 m. long; internodes hollow, up to 10 mm. thick, glabrous to densely papillose-pubescent; nodes glabrous; sheaths glabrous to pilose, the margin ciliate with hairs to 3 mm. long; auricular hairs to 4 mm. long; ligule 0.5-2.0 mm. long, glabrous to ciliate; leaf blades linear to lanceolate, 5-15 cm. long, 6-26 mm. wide, glabrous or commonly pilose. Panicle usually 5-12 cm. long, the longest branch to 8 cm. long; spikelets few, long-pedicellate; panicle branches ascending to diverging, glabrous to pilose. Spikelets obovate, 3.6-5.5 mm. long; first glume 1.6-3.2 mm. long, 5-13-nerved; second glume 7-13-nerved; lower (sterile) lemma 9-11-nerved, its palea half as long as the lemma or longer; flower absent or staminate with anthers rudimentary or up to 2.7 mm. long, white; stigmas white; caryopsis 2.4-2.7 mm. long, light brown. Chromosome number $n = 18$.

Forest margins, thickets, and brush; elevations 900-2,300 m. This species is common in Costa Rica, mostly on the Pacific slope. It is not known from the lower and dryer parts of Guanacaste. Flowering most commonly from June to January. Central Mexico to northwestern South America (Colombia, Venezuela, and Ecuador).

This species has usually been included in *L. sorghoidea* until recently, but differs in the delicate, open panicle with few spikelets.

***Lasiacis oaxacensis* (Steud.) Hitchc., Proc. Biol. Soc. Wash. 24:45. 1911, var. *oaxacensis*. *Panicum oaxacense* Steud., Syn. Pl. Glum. 1:73. 1854.**

Perennial; culms extensively creeping and rooting at the nodes, 0.5-2.0 m. long, much branched, the terminal portions more or less ascending; internodes 2-5 mm. thick, usually solid, glabrous; nodes glabrous; sheaths glabrous or rarely somewhat puberulent when young; margins usually ciliate; ligule prominent, 2-6 mm. long (see also var. *mazonii* with short ligules), brown, often puberulent or hispid on the back, the edges ciliate or glabrous; leaf blades 13-29 cm. long, 12-24 mm. wide, narrowly linear-lanceolate, glabrous, usually scabrous on edges and midrib, rarely puberulent when young. Inflorescence mostly terminal, 16-31 cm. long, the longest branch 4-24 cm. long; branches widely spreading, mostly naked on lower two-thirds; spikelets pedicellate in



FIG. 106. *Lasiacis nigra*. A, culm segment; B, base of plant; C, inflorescence; D, spikelet.

pairs or small clusters toward the ends of the branches. Spikelets 3.8-4.2 mm. long; first glume 1.6-2.3 mm. long, 4-9-nerved; second glume 7-11-nerved; lower lemma with an equal palea and a staminate flower with well-developed lodicules; anthers 1.0-2.3 mm. long, sometimes rudimentary; upper (fertile) lemma 3.2-3.6 mm. long; anthers 1.7-2.3 mm. long; stigmas purple; caryopsis 2.0 mm. long. Chromosome number $n = 18$.

Forest margins and openings, roadsides, sometimes in cafetales, mostly on the Pacific slope. This species is more weedy than most of the others of the genus, and may form sizable patches in disturbed sites. Mostly blooming from November to April. Southern Mexico to Peru, Ecuador, Venezuela, and Colombia; Greater Antilles.

Var. **maxonii** (Swallen) Davidse, Ann. Missouri Bot. Gard. 64:375. 1977. *L. maxonii* Swallen, loc. cit. 30:231. 1943.

This variety differs in having short ligules, 1.5 mm. or less long.

Costa Rica and Panama; Honduras.

Lasiacis procerrima (Hack.) Hitchc., Proc. Biol. Soc. Wash. 24:145. 1911. *Panicum procerrimum* Hack., Oesterr. Bot. Z. 51:431. 1901. Figure 107.

Short-lived perennial or annual; culms decumbent at the base and producing conspicuous unbranched prop roots from lower nodes; culms in clumps, 0.5-5 m. long, simple or sparingly branched, 4-12 mm. thick; internodes hollow, glabrous or rarely puberulent below the glabrous nodes; sheaths glabrous or puberulent, glaucous; ligule 0.5-1.5 mm. long; leaf blades 14-42 cm. long, 14-57 mm. wide, the base cordate and clasping the stem, ciliate; surfaces glabrous to velutinous, rarely hispid, glaucous beneath. Inflorescence a large, very open panicle, 20-120 cm. long, about as wide; spikelets mostly borne toward the ends of the branches. Spikelets 3.0-4.8 mm. long; first glume 1.4-3.0 mm. long, 7-11-nerved; second glume 9-11-nerved; lower (sterile) lemma 9-11-nerved, usually enclosing a palea at least three-fourths as long; flower usually staminate, rarely perfect; anthers 1.8 mm. long, rarely rudimentary; upper (fertile) lemma 3.1-3.4 mm. long, 1.8-2.1 mm. wide; lemma black to grayish brown at maturity, its upper margins not inrolled; anthers 1.6-1.9 mm. long; stigmas white; caryopsis 2.3 mm. long, dark brown. Chromosome number $n = 18$ from Costa Rican specimens.

Common on exposed road embankments and brushy open slopes, up to 1,800 m. elevation, most common on the Pacific Slope. Blooming from June to January. Mexico to Northern South America, from Peru to Guyana. Common names: Alajuela, Cañuela.

Lasiacis rhizophora (Fourn.) Hitchc. Proc. Biol. Soc. Wash. 24:145. 1911. *Panicum rhizophorum* Fourn., Mex. Pl. 2:31. 1881.

Perennial; culms creeping, rooting at the nodes, freely branching; upper parts of culms erect to 1 m. tall; culms slender, 2-3 mm. thick, solid; internodes puberulent toward the apex; nodes glabrous or puberulent; sheaths shorter than the internodes, puberulent, hirsute, or papillose-hispid, the overlapping margin ciliate above; auricular hairs of sheath apex prominent; ligule a ciliate membrane, 0.4-1.1 mm. long, tipped with hairs



FIG. 107. *Lasiacis procerrima*. A, culm base with prop roots; B, leaf blade with cordate base; C, portion of inflorescence; D, spikelet; E, two views of an upper (fertile) floret.

1.5-3.5 mm. long; leaf blades lanceolate, 8-17 cm. long, 16-37 mm. wide; surfaces hispid, puberulent, scabrous or glabrous; base asymmetrical, one side cordate-clasping. Inflorescence 10-24 cm. long, the longest branch up to 11 cm. long; branches ascending or spreading, scabrous or puberulent; spikelets clustered in pairs or small groups toward the tips of the branches. Spikelets 3.1-4.0 mm. long; first glume 1.4-2.1 mm. long, 5-7-nerved, second glume 7-9-nerved; lower (sterile) floret lacking a flower or rarely with rudimentary stamens, the lemma 7-9-nerved, its palea three-fourths or less as long; fertile lemma 2.9-3.2 mm. long, black to dark brown; anthers 1.6-1.9 mm. long; stigmas purple; caryopsis 2.2-2.4 mm. long. Chromosome number $n = 18$ from a Costa Rican specimen.

Pacific slope, 850-1,400 m. elevation. Known from Tilaran, Monteverde, the Meseta Central, and Cañas Gordas. Blooming July to February. Central Mexico to Colombia.

Lasiacis rugelii (Griseb.) Hitchc., Bot. Gaz. (Crawfordsville) 51:302. 1911, var. ***pohlii*** Davidse, Ann. Missouri Bot. Gard. 64:375. 1977. *Panicum rugelii* Griseb., Cat. Pl. Cuba 233. 1866. Figure 108.

Perennial; culms caespitose, 1-5 m. long, erect below, weak and arching and climbing into brush, occasionally in part procumbent and rooting, internodes hollow, 3-6 mm. thick, usually glabrous or with a line of hairs on one side or entirely puberulent; nodes glabrous; sheaths densely puberulent; overlapping margin ciliate; auricular hairs 1.5 mm. long, pseudopetiole 1-3 mm. long; ligule an inconspicuous whitish membrane, 0.4 mm. or less long; leaf blades ovate-lanceolate to lanceolate, 4-7 cm. long, 8-15 mm. wide, glabrous or minutely puberulent; base asymmetric, abruptly narrowed to nearly truncate. Panicle usually not fully exerted, 3-7 cm. long, the longest branch 3.5 cm. or less long; branches ascending to spreading, pubescent or scabrid. Spikelets globose, 3.6-4.2 mm. long; first glume 1.7-2.5 mm. long, 7-9-nerved; second glume 9-nerved; lower (sterile) lemma 9-nerved, with a palea at least half as long but lacking a flower; upper (fertile) lemma 3.8-4.0 mm. long, brown; caryopsis 2.2-2.4 mm. long.

Rain forests, shaded roadsides, riverbanks; elevation 500-700 m. Blooming July to January. Known in Costa Rica from Pejibaye (the type), Turrialba, and La Palma (Volcán Arenal). Guatemala to Panama.

This variety replaces var. *rugelii* in Central America. It differs from var. *rugelii* in having the culm internodes glabrous or with only a line of puberulence, var. *rugelii* having pubescent internodes, as well as in having smaller, more globose spikelets.

Lasiacis ruscifolia (H.B.K.) Hitchc., Proc. Biol. Soc. Wash. 24:145. 1911, var. ***ruscifolia***. *Panicum ruscifolium* H.B.K., Nov. Gen. & Sp. Pl. 1:101. 1816. *Lasiacis glabra* Swallen, Ceiba 4:287. 1955.

Caespitose perennial; culms 1-8 m. long, erect at the base, arching, the upper parts leaning on brush; internodes woody, usually hollow, 5-12 mm. thick, variously glabrous or with a single line of pubescence, or puberulent, or papillose-pubescent; nodes glabrous or puberulent; sheaths papillose-hispid with hairs up to 3.5 mm. long, or puberulent or glabrous; overlapping sheath margin ciliate; auricular hairs up to 3 mm. long; ligule



FIG. 108. *Lasiacis rugelii* var. *pohlii*. A, base of plant; B, flowering branch; C, spikelet.

usually inconspicuous, 0.3-1.0 mm. long, glabrous or ciliate; leaf blades ovate to lanceolate, 4-16 cm. long, 10-56 mm. wide, with an asymmetric clasping base that is usually ciliate with hairs to 3 mm. long. Panicle rather dense, 2-22 cm. long, the longest branch 1-9 cm. long, the lower branches widely separated and spreading. Spikelets globose, 2.6-4.0 mm. long; first glume 1.0-2.2 mm. long, 9-13-nerved; second glume 11-13-nerved; lower (sterile) lemma lacking a flower, 11-13-nerved, its palea at least two-thirds as long as the lemma; upper (fertile) lemma 2.8-3.6 mm. long, dark brown to grayish black; anthers 1.4-2.3 mm. long, white; stigmas white; palea usually deeply concave; caryopsis 2.0-2.5 mm. long. Chromosome number $n = 18$.

Dry, rocky savannas, gallery forests; common in northern Guanacaste; Barranca; La Garita; elevations usually below 500 m. Blooming mostly June to February. Northern Mexico to northwestern South America (Colombia, Venezuela, and Ecuador); Cuba and Jamaica.

Var. *velutina* (Swallen) Davidse, Ann. Missouri Bot. Gard. 64:375. 1977. *L. velutina* Swallen, Ceiba 4:288. 1955.

This variety has velutinous leaf blades and pilose panicle branches.

Some of our specimens from Guanacaste approach this in leaf pubescence, but lack pilose panicle branches. Honduras; Venezuela.

***Lasiacis scabrior* Hitchc., Proc. Biol. Soc. Wash. 40:85. 1927.**

Caespitose perennial; culms erect or arching and clambering over vegetation, 1-6 m. tall; internodes up to 13 mm. thick, hollow, woody, papillose-pubescent or puberulent near the apex or in a vertical line; nodes glabrous; sheaths usually pubescent or villous, the hairs up to 2 mm. long, rarely becoming glabrous with age; overlapping margin and throat ciliate, the hairs 2.0-3.5 mm. long; ligule a conspicuous, usually dark brown lacerate membrane, 3.5-7.0 mm. long, glabrous, appressed-pubescent or ciliate, the hairs to 3.0 mm. long; leaf blades linear to lanceolate, 6-16 cm. long, 10-30 mm. wide; upper surface scabrid or puberulent along the midrib, especially toward the base; lower surface usually densely puberulent, or becoming glabrous; base asymmetric; margin scabrid. Panicle usually 4-9 cm. long, rather dense, nearly spherical, the longest branch 1-5 cm. long; base always included in the upper sheath. No large terminal inflorescence present, but numerous inflorescences borne on secondary branches; panicle branches usually pubescent or densely puberulent below, scabrid above. Spikelets obovoid, 3.5-4.5 mm. long; first glume 1.2-2.8 mm. long, 7-11-nerved; second glume 9-13-nerved; lower (sterile) lemma 11-13-nerved, its palea two-thirds as long or longer; flower lacking or rudimentary; upper (fertile) lemma 3.5-3.6 mm. long, dark brown; anthers ca. 2 mm. long, white; caryopsis 2.1-2.3 mm. long.

Clearings, trails, margins of wet forests; sea level to 1,100 m. elevation. Northern Costa Rica to the Panamanian border. July to April. Oaxaca and Vera Cruz, Mexico, to Colombia, Ecuador, and Peru.

***Lasiacis sloanei* (Griseb.) Hitchc., Bot. Gaz. (Crawfordsville) 57:302. 1911. *Panicum sloanei* Griseb., Fl. Brit. W. Ind. 551. 1864.**

Panicum latifolium Hamilt. Prodr. Pl. Ind. Occ. 10. 1825, non *P. latifolium* L., 1753.

Caespitose perennial; culms erect or clambering, 1-6 m. long; internodes hollow, 4-10 mm. thick, glabrous or with a vertical line of puberulence; nodes glabrous; sheaths glabrous except for ciliation on the upper margin and throat; auricular hairs up to 3 mm. long; pseudopetioles up to 3 mm. long, usually pubescent; ligule membranaceous, 0.5-1.0 mm. long, ciliate or ciliate; leaf blades 8-18 cm. long, 13-45 mm. wide, ovate to lanceolate; upper surface puberulent or scabrous at the base of the midrib or along its length, otherwise shiny and glabrous on both surfaces; base asymmetrical. Panicle open, with relatively few, short-pedicellate spikelets appressed to the branches; length 6-34 cm.; longest branch 2-15 cm. long. Spikelets 4.0-5.3 mm. long, first glume 1.5-2.6 mm. long, 7-9-nerved; second glume 9-13-nerved; lower (sterile) lemma 9-13-nerved, with a palea at least three-fourths as long; flower lacking or staminate; anthers 1.5-2.0 mm. long or sometimes rudimentary; upper (fertile) lemma 3.8-4.3 mm. long; anthers 1.8-2.2 mm. long, white; stigmas white; caryopsis 2.3-2.6 mm. long, whitish. Chromosome number $n = 18$.

Moist forest margins, in brush and thickets along roadsides. Elevations below 1,000 m. Northwestern Guanacaste; Pandora; Rio Térraba below Boruca; common in the canyon of the Rio Reventazón at CATIE at Turrialba. July to March. Northeastern Mexico to Colombia, Venezuela, and Ecuador; Greater Antilles.

Lasiacis sorghoidea (Desv. ex Hamilt.) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:338. 1917., var. ***sorghoidea***. *Panicum sorghoideum* Desv. ex Hamilt., Prodr. Pl. Ind. Occ. 10. 1825.

Caespitose perennial; culms 1-10 m. long, erect at the base, often coarse, arching and leaning on vegetation; internodes woody, 5-15 mm. thick, hollow, variously glabrous, papillose-pubescent, or with a single line of pubescence; nodes glabrous; sheaths often papillose-pubescent, especially toward the apex, the hairs up to 3.5 mm. long, rarely glabrate; overlapping margin and throat ciliate, the hairs up to 3 mm. long; collar densely pubescent; ligule inconspicuous, usually 0.3-1.5 mm. long, usually ciliate; leaf blades elliptic-lanceolate to linear-lanceolate, 6-23 cm. long, 6-46 mm. wide, the upper surface usually puberulent, rarely heavily pubescent; lower surface usually velutinous or puberulent. Panicle usually large and prominent, 5-35 cm. long, the branches usually ascending, spreading at maturity. Spikelets obovate to elliptic, usually purple when immature, 3.0-4.3 mm. long; first glume 1.2-2.7 mm. long, 7-11-nerved; second glume 9-13-nerved; lower (sterile) lemma 9-11-nerved, with a palea half or more as long as the lemma; with or without a staminate flower; anthers 1.7-2.0 mm. long; upper (fertile) lemma 2.9-3.8 mm. long, dark brown, with a dorsal indentation; anthers 1.9-2.3 mm. long; caryopsis 1.8-2.3 mm. long. Chromosome number $n = 18$.

Forest margins, brushy areas, roadsides; mostly at elevations below 1,100 m. Mountains of western Costa Rica, from Guanacaste to the Panamanian border. October through May. Oaxaca and Veracruz, Mexico, to Brazil and Argentina; West Indies.

Lasiacis standleyi Hitchc., Proc. Biol. Soc. Wash. 40:86. 1927. *L.*

longiligula Swallen, Ann. Missouri Bot. Gard. 30:232. 1943. *L. lucida* Swallen, Ann. Missouri Bot. Gard. 30:231. 1943.

Creeping perennial, the culms rooting at the nodes, the plants lacking strong central canes; culms with terminal growths erect or scrambling in brush for several meters; internodes 2-4 mm. thick, hollow, thin-walled, puberulent toward the apex and with a longitudinal line of puberulence or rarely pubescent; nodes glabrous; sheaths variously puberulent, pubescent, or papillose-hispid with hairs to 3 mm. long, occasionally glabrous; overlapping margin ciliate with hairs to 2.5 mm. long; collar glabrous or puberulent; ligule a prominent, usually dark brown lacerate membrane, 4.5-9.0 mm. long, ciliate on one or both margins with hairs to 3 mm. long; leaf blades 10-18 cm. long, 8-35 mm. wide, broadly elliptic-lanceolate to linear; upper surface usually strongly scabrous, puberulent, hispidulous, or glabrous; base asymmetric; margins sometimes undulate. Panicle rather compact, 7-27 cm. long, the longest branch 2-15 cm. long. Spikelets 3.7-5.0 mm. long; first glume 9-13-nerved; lower (sterile) lemma 11-13-nerved, with a palea one-fourth or less as long, lacking a flower; upper (fertile) lemma 3.4-4.1 mm. long; anthers white; stigmas purple; caryopsis 2.1-2.4 mm. long. Chromosome number $n = 18$.

Cloud and montane forests, from 600 to 2,000 m. elevations; in forests, clearings, along trails and in brush. Mountains of western Costa Rica, from northern Guanacaste to the Panamanian border. October to April. Guatemala to Colombia, Venezuela, and Ecuador.

LEERSIA Swartz Nomen Conservandum

REFERENCE: G. L. Pyrah, Taxonomic and distributional studies in *Leersia* (Gramineae), Iowa State J. Sci. 44:215-270. 1969.

Perennial caespitose or rhizomatous grasses; inflorescence a terminal panicle. Spikelets consisting of a naked laterally compressed and keeled awnless floret; glumes reduced to minute ridges or a minute cupule at the tip of the pedicel; lemma strongly keeled, 5-nerved; palea keeled, 3-nerved; stamens 1-6; disarticulation below the floret, the cupule remaining on the pedicel.

Leersia is a genus of about 17 species, most of them occurring on wet soil or in marshes in temperate or tropical regions of the entire world. The genus is apparently closely related to *Oryza*, from which it differs in lacking sterile florets below the fertile one, and in the lack of awns. The plants often form large, tangled colonies in marshy areas. The foliage in some species, notably *L. hexandra*, bears minute barbs that cause painful scratches in the human epidermis. (Oryzoideae: Oryzeae.)

KEY TO SPECIES OF *Leersia*

- 1a. Spikelets pectinate-ciliate, narrowly elliptical, 3-5 mm. long; stamens 6; plants rhizomatous, in wet places *L. hexandra*

- 1b. Spikelets not ciliate, usually glabrous, broadly elliptical, 2-3 mm. long; stamens 2; plants caespitose, in upland forests *L. ligularis* var. *grandiflora*

***Leersia hexandra* Swartz, Prodr. Veg. Ind. Occ. 21. 1788. Figure 109.**

Plants perennial; culms 25-150 cm. long, decumbent and rooting at lower nodes; rhizomes slender, elongated; plants sometimes floating in shallow water; branching common from rhizomes or decumbent portions of stems; culms 1.0-3.5 mm. thick, hollow, glabrous or retrorsely scabrous; nodes retrorsely pubescent; sheaths strongly scabrous to glabrous, the margins ciliate, midrib somewhat keeled, upper margins auriculate, the auricles acute, joined to the ligule; ligules membranaceous, 1-6 mm. long; blades flat, 5-25 cm. long, 3-15 mm. wide, from strongly scabrous to glabrous. Peduncle smooth, up to 11 cm. long; panicle narrow, open, rather simple, 5-15 cm. long, the branches few. Spikelets subsessile, imbricated along the slender, zigzag branchlets, elliptic-oblong, apiculate, 3-5 mm. long, 1.0-1.5 mm. wide; lemma and palea of equal length, but the lemma much wider; keels of lemma and palea strongly scabrous-ciliate; margins, nerves, and internerves of lemma somewhat scabrid; spikelets whitish or pink; stamens 6, 2-3 mm. long. Chromosome number $n = 24$ from Costa Rican material.

Common in wet places, ditches, moist pastures, marshes, sometimes floating in shallow water, often forming enormous stands in marshes, as at Laguna de Arenal. Widespread in Costa Rica from sea level to 1,400 m. elev. Blooming probably yearlong. Subtropical and tropical regions of both hemispheres; in North America from the southeastern United States to Texas; southern Mexico to southern South America.

Pyrh has pointed out that there is practically no seed set in this species. In the sites where it grows, it is able to spread very freely by vegetative means. Because of the strongly scabrous sheaths, the plants often cause severe scratches, which readily become infected.

***Leersia ligularis* Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 5:168. 1839. var. *grandiflora* (Doell) Pyrah, Iowa State J. Sci. 44:236. 1969. *L. distichophylla* Bal. and Poit., Bull. Soc. Hist. Nat. Toulouse 12:221. 1878. *L. grandiflora* (Doell) Prodoehl, Bot. Arch. 1:219. 1922. Figure 109.**

Plants perennial; culms decumbent to erect, to 2 m. tall, sometimes rooting at lower nodes, unbranched, hollow; nodes glabrous to retrorse-pubescent; leaves numerous, the lower ones with overlapping sheaths; upper sheaths shorter than the internodes; midribs of sheaths somewhat keeled above; sheath auricles present, acute, united to the edges of the ligule; ligules 1-4 mm. long, membranaceous; blades up to 40 cm. long and 25 mm. wide, glabrous or hispid on the upper surface. Peduncle glabrous; panicle up to 45 cm. long, ovoid, very open; branches 1-4 at the lower nodes. Spikelets broadly elliptical, 2-3 mm. long, 1.2-1.6 mm. wide, subsessile along the outer fourth of the spreading branches, glabrous or slightly scabrid; anthers 2, 1.0-1.5 mm. long.

Occasional in the Meseta Central; Rincón de la Vieja; elevations



FIG. 109. *Leersia* species. *L. hexandra*: A, inflorescence; B, spikelet; *L. ligularis*, var. *grandiflora*: C, inflorescence; D, spikelet.

900-1,100 m., in rocky open woods or brush. Blooming October to June. Guatemala to Colombia; Brazil, Paraguay, Argentina.

LEPTOCHLOA Beauvois

Annual or perennial grasses. Inflorescence a panicle of slender, 1-sided racemes, arranged racemosely along an elongated common rachis; spikelets short-pedicellate, appressed in 2 rows along the lower sides of a slender triquetrous rachis, somewhat overlapping. Spikelets laterally compressed and keeled, of 2-6 florets, disarticulating above the glumes and between the florets, the rachilla extended above the ultimate fertile floret and often bearing a minute or moderate-sized rudiment at its apex; glumes 1-nerved, narrow, acuminate; lemmas 3-nerved, the lateral nerves close to the margins, the apex bifid and sometimes bearing a short awn from the split; palea nearly as long as the lemma; anthers 2 or 3, small; caryopsis free, angular, grooved on the side opposite the embryo.

Leptochloa is a genus of about 20 species of rather weedy grasses, distributed in warm temperate and tropical regions of both hemispheres. In spikelet structure, it is similar to such genera as *Gouinia*, *Triplasis*, and *Eragrostis*. Because of the arrangement of the nearly sessile spikelets in two rows along the simple panicle branches, authors have sometimes placed the genus in the tribe Chlorideae. (Chloridoideae: Eragrosteae.)

KEY TO SPECIES OF *Leptochloa*

- 1a. Sheaths more or less papillose-hirsute; glumes nearly as long as spikelet *L. filiformis*
- 1b. Sheaths glabrous; glumes much shorter than spikelet 2
 - 2a. Ligule a ciliate membrane 0.3-0.7 mm. long; lemmas often awned *L. virgata*
 - 2b. Ligule a dense row of stiff white hairs, 1.5-3.0 mm. long; lemmas awnless *L. scabra*

***Leptochloa filiformis* (Lam.) Beauv., Ess. Nouv. Agrost. 71, 166. 1812. *Festuca filiformis* Lam., Tabl. Encycl. 1:191. 1791. Figure 110.**

Caespitose annual; plants 10-130 cm. tall; culms erect, unbranched or branched from the base, up to 3 mm. thick, hollow, glabrous; nodes glabrous; sheaths mostly overlapping, more or less papillose-hirsute; ligule a lacerate-ciliate membrane, 0.5-1.5 mm. long, decurrent on the sheath margins; blades flat, glabrous or minutely scabrid, 4-23 cm. long, 3-9 mm. wide. Peduncle glabrous, exserted 3-15 cm.; inflorescence solitary, terminal, oblong, 5-50 cm. long, a raceme of simple racemose branches, borne singly or several at one node along the rachis; branches up to 10 cm. long, stiffish, slender, the rachis triquetrous, bearing short-pedicellate appressed spikelets in 2 rows along the lower 2 sides. Spikelets 2-3-flowered, 1.8-3.0 mm. long; glumes nearly as long as the spikelet; first glume subulate, keeled, 1-nerved, 1.3-2.0 mm. long; second glume narrowly lanceolate, keeled, 1-nerved, 1.5-2.0 mm. long; lemmas 1.1-1.8 mm. long, ovate, acute, keeled, slightly bifid at the apex, awnless, the keel and lateral nerves finely ciliate; palea nearly as long as the lemma; rachilla prolonged beyond the upper floret and bearing a minute rudiment at its tip; anthers 2, 0.2-0.3 mm. long, yellow.

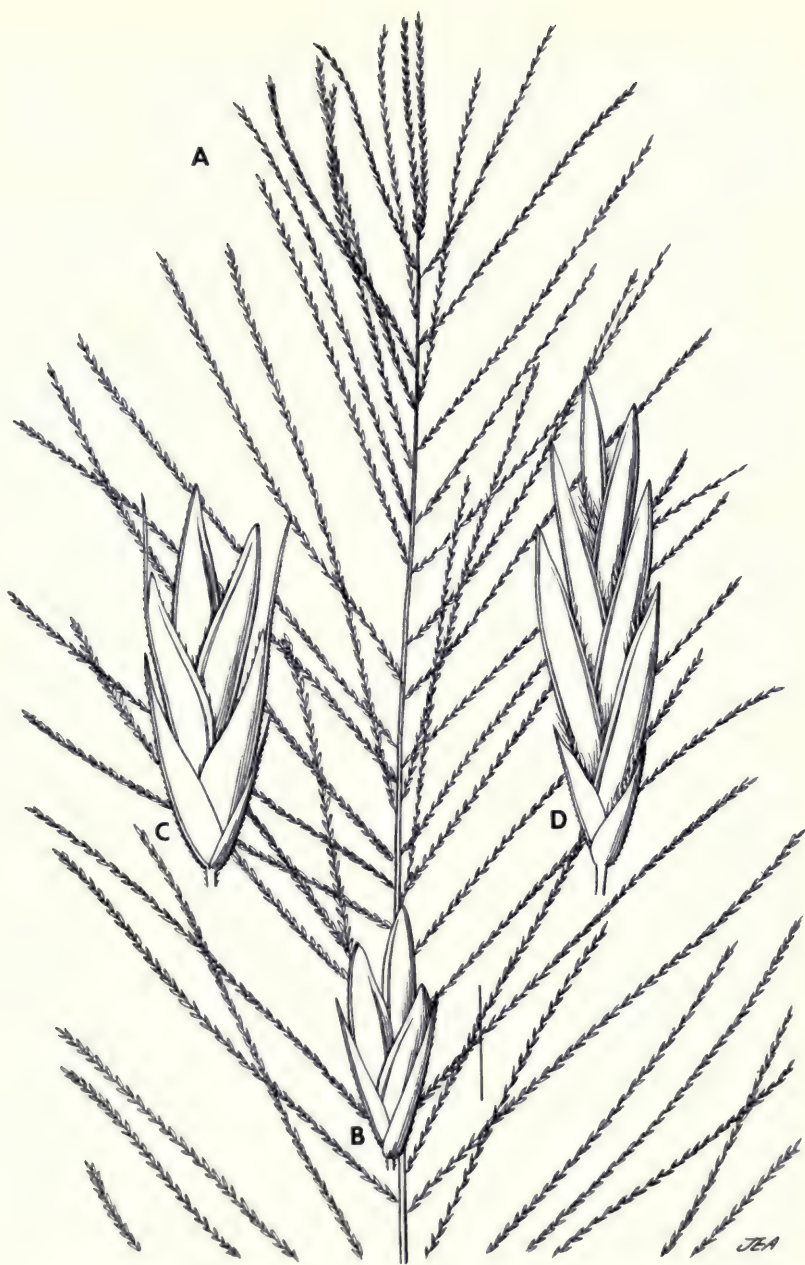


FIG. 110. *Leptochloa* species. *L. filiformis*: A, panicle; B, spikelet; *L. virgata*: C, spikelet; *L. scabra*: D, spikelet.

Weedy open areas at low elevations; common in Guanacaste. June to October, probably yearlong. Southern United States to Panama; West Indies; South America.

***Leptochloa filiformis* X *L. virgata*.**

A large, vigorous specimen intermediate between these species and possessing defective pollen, was collected from Finca la Taboga (*Pohl & Davidse 10133*). It is a probable hybrid of these species, which are common in the immediate area.

***Leptochloa scabra* Nees, Agrost. Bras. 435. 1829. Figure 110.**

Caespitose annual, in small clumps; plants 90-120 cm. tall; culms erect, branching from the lower nodes, up to 6 mm. thick, hollow, glabrous; nodes glabrous, constricted; prophylla up to 12 cm. long; sheaths mostly overlapping, glabrous; ligule a dense row of stiff, white hairs, 1.5-3.0 mm. long; blades up to 50 cm. long, 6-14 mm. wide, minutely scabrid, the margins very scabrous; dewlap purple. Peduncle mostly included in the upper sheath; inflorescence solitary, terminal, open-cylindrical, up to 40 cm. long, composed of numerous lax racemes attached singly or in pairs along the length of the rachis; racemes 7-10 cm. long; spikelets rather densely arranged in 2 rows along the lower sides of the rachis of the simple branch, overlapping at about 30° inclination to the rachis. Spikelets pale, 3.7-4.5 mm. long, with 3-6 florets, narrowly elliptical in outline; glumes and florets keeled; first glume ovate, acuminate, 1-nerved, 0.7-1.1 mm. long; second glume similar, 1-nerved, 1.2-1.7 mm. long; lemmas 2.3-1.4 mm. long, the upper ones shorter than the lower, ovate-oblong, abruptly acuminate or apiculate, 3-nerved, the lower part of keel and marginal nerves softly ciliate; palea equal to the lemma or slightly exceeding it; anthers 3, 0.2-0.3 mm. long; rachilla prolonged beyond the uppermost floret as a naked bristle.

Uncommon; railroad yard at Limón, Siquirres, Zent, Río San Carlos; open areas at low elevations. June to December. Louisiana and Mexico to Costa Rica; West Indies; Venezuela and Colombia to Peru and Brazil.

***Leptochloa virgata* (L.) Beauv., Ess. Nouv. Agrost. 71, 166. 1812. *Cynosurus virgatus* L., Syst. Nat. ed. 10, 2:876. 1759. Figure 110.**

Caespitose, in small clumps; plants 40-110 cm. tall, erect; branching mostly from base and lower nodes; basal portions of culms sometimes decumbent and rooting; culms 2-3 mm. thick, hollow, glabrous; sheaths glabrous, shorter or longer than the internodes; ligule a ciliate membrane, 0.3-0.7 mm. long; blades 10-26 cm. long, 7-10 mm. wide, glabrous. Peduncle exerted 5-28 cm.; inflorescence solitary, terminal, 10-22 cm. long, of few to many lax racemes, attached singly or whorled, floriferous to the base, 7-11 cm. long; spikelets overlapping, appressed laterally to the lower sides of the rachises. Spikelets often purplish, 2.5-3.6 mm. long; glumes scabrous on the keel, the first 1.2-1.6 mm. long, 1-nerved, subulate to narrowly lanceolate, second glume 1.8-2.3 mm. long, 1-nerved, narrowly lanceolate; florets 3-5; lowermost lemma 1.8-2.2 mm. long, the upper ones shorter, keeled, narrowly ovate, slightly bifid at the apex, sometimes bearing an awn up to 2.2 mm. long (often only the lowermost lemma awned); lateral nerves marginal, softly ciliate on the upper half, the keel glabrous; palea nearly as long as the lemma;

ultimate segment of the rachilla bearing a rudiment of varying size; anthers 2, 0.2-0.3 mm. long, yellow or purplish. Chromosome number $n = 20$ from Costa Rican material.

Disturbed soil of fields, roadsides, pastures, and forest margins; low elevations, mostly near the Pacific Coast; Limón area. March to December, possibly yearlong. Southern United States and Mexico to Argentina; West Indies.

LEPTOCORYPHIUM Nees

Caespitose perennial from deeply buried hard cormose bases; inflorescence a terminal panicle. Spikelets dorsally compressed, disarticulating whole from the pedicel; first glume lacking or represented only by a cupule at the tip of the pedicel; second glume and sterile lemma subequal, about as long as the fertile floret, both strongly ribbed and covered with long silky hairs arising from the nerves; sterile lemma lacking a palea or flower; fertile floret chartaceous, brown, its edges not inrolled; palea similar, about equal to the lemma, its tip not enclosed by the lemma.

A small genus of one or two species of savanna grasses, ranging from Mexico to Argentina. The genus appears to be closely related to *Anthaenanthia* of the southern United States. (Panicoideae: Paniceae.)

Leptocoryphium lanatum (H.B.K.) Nees, *Agrost. Bras.* 84. 1829. *Paspalum lanatum* H.B.K., *Nov. Gen. & Sp.* 1:94, pl. 29. 1816. Figure 111.

Perennial, in small hard clumps, the bases of the plants hard, cormose, buried in soil; plants 60-90 cm. tall, erect, the leaves mostly basal, their sheaths breaking down into harsh fibers; culms unbranched, 1-2 mm. thick, smooth, pithy; nodes dark colored, glabrous; leaf sheaths glabrous except long-pilose on the sheath auricles; ligule a minute ciliate membrane, ca. 0.2 mm. long; leaf blades mostly involute, up to 40 cm. long, 2-3 mm. wide, glabrous except long-pilose on their lower margins, the upper surface strongly ridged; uppermost blade much reduced. Peduncle elongated, slender, glabrous. Panicle solitary, terminal, slender, cylindrical but loose, 8-15 cm. long, 1-3 cm. wide, the short branches ascending; aspect grayish and fuzzy. Spikelets ascending, appressed to the branches, dorsally compressed, 3.5-4.0 mm. long, silky because of the long grayish or white hairs which densely cover them. The tip of the pedicel is dilated into a hollow cupule from which the spikelet disarticulates, and which may represent a reduced first glume. Second glume and sterile lemma 3.2-3.7 mm. long, strongly 5-7-nerved, the internerves thin and translucent; nerves densely beset with papillose-based silky hairs up to 2 mm. long, either appressed or spreading at right angles to the spikelet; fertile floret narrowly ovate, acute, the lemma and palea similar, faintly nerved, their tips hyaline; margins of the lemma covering the lower portions of the palea but not the tip; anthers 3, purple, ca. 2.5 mm. long. Chromosome number $n = 10$ from a specimen from Honduras. South American reports indicate $n = 20$ as well.

This is one of the most xeric of the savanna grasses, found on very dry sites, especially on volcanic tuff deposits. The deeply buried plant bases afford protection from fires. Many specimens have charred basal



FIG. 111. *Leptocoryphium lanatum*. A, panicle; B, buried plant base; C, spikelet; D, caryopsis; E, fertile floret.

leaves, indicating the frequency of fires in these habitats. Flowering, as in many savanna grasses, is synchronous over large areas and is completed quickly. Dry savannas, in Costa Rica under 300 m. but elsewhere to 1,000 m.; northern Guanacaste, Buenos Aires, Boruca, Cañas Gordas; not common. February to July. Mexico to Argentina.

LITHACHNE Beauvois

Caespitose herbaceous perennials. Spikelets unisexual. Pistillate spikelets: Solitary, terminal on slender clustered axillary peduncles, sometimes with 1-several pedicellate staminate spikelets below the pistillate one; glumes of pistillate spikelets equal, green, herbaceous, many-nerved, caudate-ovate, much exceeding the floret; floret 1, bony, shining, the lemma obpyramidal, truncate, cucullate, laterally compressed, borne on a thick attached rachilla internode; margins of lemma clasping a bulging palea of bony texture; disarticulation above the glumes which may later fall from the pedicel; pedicel flattened, keeled, enlarged below the tip. Staminate spikelets: Either borne below the pistillate one on axillary peduncles or in a small terminal panicle. Staminate spikelet: A naked floret lacking glumes, borne on a short, thickened stipe above the point of disarticulation; lemma and palea about equal, narrowly lanceolate, thin and membranaceous, white; lemma 3-nerved, awnless; palea similar, 2-nerved; anthers 3, nearly as long as the floret, borne on very short filaments; floret disarticulating from the pedicel after flowering.

Lithachne is a small genus of forest-inhabiting bambusoid grasses of the tropics of the western hemisphere. The genus is related to *Olyra*, *Raddia*, *Cryptochloa*, and other herbaceous bambusoids. The asymmetric, truncate-based leaf blades and the rigid, helmet-shaped fertile florets are distinctive. Earlier authors interpreted the spikelets as panicoid in structure, and assigned the genus to the Panicoideae. Leaf anatomy indicates that it is bambusoid. (Bambusoideae: Olyreae.)

Lithachne pauciflora (Swartz) Beauv. ex Poir., Dict. Sci. Nat. 27:60. 1823. *Olyra pauciflora* Sw., Prodr. Veg. Ind. Occ. 21. 1788. Figure 112.

Caespitose perennial; clumps usually small; culms erect or arching, 20-75 cm. tall, simple; internodes glabrous, ca. 1 mm. thick, hollow; nodes shrunken in dry specimens, with a sharp ridge below and above the node; lower internodes elongated, the upper much shorter; lower sheaths bladeless or with reduced blades, much shorter than the internodes; upper sheaths overlapping, the foliage clustered near the apex of the culms; sheaths sparsely hispidulous, slightly keeled; ligules membranaceous, minute, ca. 0.5 mm. long; leaf blades 4-10 cm. long, 1.5-3 cm. wide, lanceolate, asymmetric, one side broad and truncate at the base, the other narrow and rounded; pseudopetiole present between sheath and blade, ca. 1 mm. long, flattened, sparsely hirsute above; midrib of the blade ends just above the apex of the pseudopetiole. Successive leaf blades on a culm are of two types. If one leaf has the broad truncate base to the left of the midrib, the leaves above and below it will have it to the right. Pistillate spikelets: Glumes green, herbaceous, 9-11 mm. long, about equal; first glume 9-nerved, the second 7-nerved; floret bony, at first shining white, at maturity dark brown with whitish veins, truncate,



FIG. 112. *Lithachne pauciflora*. A, blooming culm; B, pistillate spikelet; C, staminate spikelet; D, pistillate floret on its rachilla internode.

cucullate, 4-5 mm. long, including the short projecting basal stipe; edges of lemma inrolled and concealing the margins of the bulging palea; both lemma and palea glabrous; caryopsis rotund, completely filling the floret. Staminate inflorescence, if present, solitary at the tip of the culm, a simple, few-flowered panicle, borne on a short peduncle; staminate spikelets also born racemously on the peduncles of the pistillate ones. Staminate spikelets: Consisting of a naked floret on a short stipe; lemma and palea ca. 5-6 mm. long, thin, white, membranaceous, glabrous, the lemma lance-acuminate, 3-nerved; palea 2-nerved. Chromosome number $n = 11$ from Costa Rican material.

Moist forests and cacao groves, Atlantic and Pacific slopes 20-1,250 m. elevation; scattered in forests but not rare; apparently blooming yearlong. Terminal staminate inflorescences are rarely found on specimens. Mexico to Ecuador, Brazil, and northern Argentina.

LOLIUM Linnaeus

Annual or weakly perennial caespitose or rhizomatous grasses; inflorescence a balanced terminal spike; spikelets placed edgewise, with the backs of the lemmas toward the rachis; first glume lacking except in the spikelet at the end of the rachis; second glume placed away from the rachis; florets several; glume and lemmas several-nerved; disarticulation at base of each floret; lemmas awned or awnless.

In the past, this genus was usually placed in the barley tribe (Triticeae). Since numerous spontaneous hybrids with members of the genus *Festuca* of the tribe Poeae are known, but none with genera of the Triticeae, it is better placed in the Poeae. Ryegrass, *Zacate ray*, *Ray Ingles*.

***Lolium perenne* L., Sp. Pl. 83. 1753. Figure 113.**

Perennial or annual; mostly caespitose but producing rhizomes in wet sites; plants 10-90 cm. tall; culms glabrous, 1-3 mm. thick, hollow; nodes glabrous; sheaths glabrous; ligule a thin membrane, up to 2 mm. long; leaf blades 3-20 cm. long, 2-6 mm. wide, with prominent auricles; inflorescence slender, to 30 cm. long; spikelets appressed to the rachis, the lower ones remote, the upper ones longer than the rachis internode adjacent, 7-20 mm. long, with 4-14 florets; second glume oblong, 5-7-nerved, shorter than the spikelet; lemmas 5-7 mm. long, narrowly elliptical, glabrous, 5-nerved, acute, sometimes awned; palea equal to the lemma, scabrid on the nerves; anthers 3, 3-4 mm. long.

Awned forms of this species occur, and have been given names. These forms interbreed freely with the awnless type, and are best regarded as agronomic forms of the species. If given taxonomic recognition, they are to be called var. *aristatum* Willd. (= var. *italicum* Parn.). Such awned plants are usually distinguished as "Italian ryegrass," and the awnless ones as "English" or "perennial ryegrass."

This species, especially the awned form, has been cultivated for forage on the volcanoes of the Cordillera Central. It can be found in moist pastures from 1,800 to 2,600 m. elevation on Irazú and Turrialba.

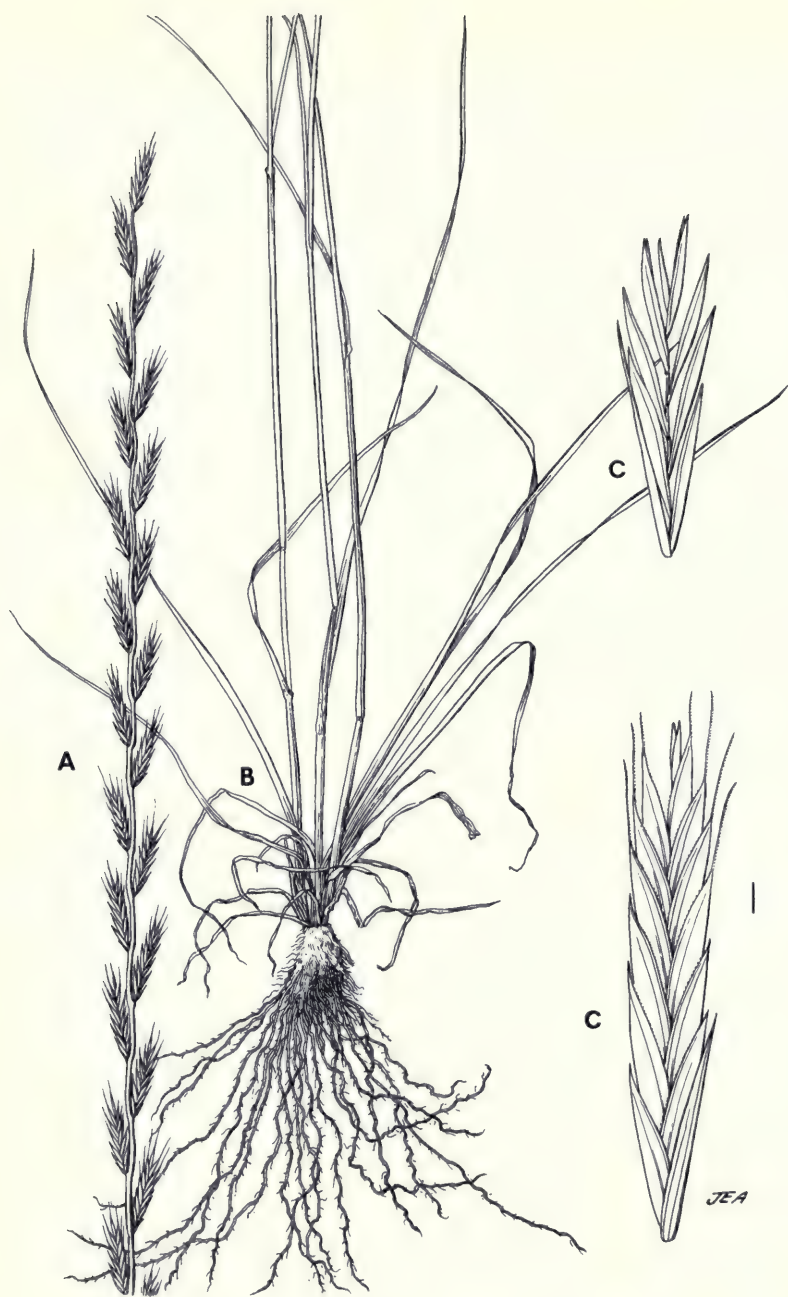


FIG. 113. *Lolium perenne*. A, inflorescence; B, plant base; C, awned and awnless spikelets.

Native to Europe, but now widely naturalized in humid temperate climates.

LORENZOCHLOA J. & C. Reeder

Densely caespitose perennial tussock grass; leaf blades usually basal, erect, involute, terete, rigid, pungent; ligules membranaceous, decurrent; inflorescence a few-flowered terminal panicle; spikelets 1-flowered; glumes short, equal, firm, truncate or emarginate, very broad, very faintly nerved; disarticulation above the glumes; floret much longer than the glumes; lemma awned, obscurely 5-nerved, more or less pubescent at the acuminate base; awn thickish, stiff, antrorsely scabrid; palea slightly shorter than the lemma; lodicules 3, oblong-elliptical. (Pooideae: Stipeae.)

Lorenzochloa erectifolia (Swallen) J. & C. Reeder, Bol. Soc. Argent. Bot. 11:239. 1969. *Muhlenbergia erectifolia* Swallen, J. Wash. Acad. Sci. 21:15. 1931. *Parodiella erectifolia* (Swallen) J. & C. Reeder., Bol. Soc. Argent. Bot. 12:279. 1968. Figure 114.

Perennial, densely caespitose; culms erect, glabrous, 15-35 (38) cm. tall; leaves mostly basal; sheaths smooth or somewhat scabrous; ligule membranous, acute, 2-4 mm. long, decurrent onto the somewhat hyaline sheath margins; blades erect, rigid, terete, scabrous, pungently pointed, 5-15 (18) cm. long, narrower than the sheaths at the base; panicles narrow, erect, 5-8 cm. long, rather few-flowered, the branches with rather conspicuous pulvini in their axils; spikelets appressed to the branches, the pedicels 1-4 mm. long, rather stout; glumes firm, subequal, 1-1.3 (1.5) mm. long, truncate and usually emarginate, obscurely 3-nerved, tinged with bronze and purple; lemma firm, obscurely 5-nerved, 2.5 mm. long, pubescent along the lower half of the midnerve, and often along the margins, pointed and pubescent at the base, the slightly scabrous apex tapering into a stout erect or slightly flexuous scabrous awn 3-5 mm. long, with a distinct line of demarcation between it and the body of the lemma; palea firm, nearly equalling the lemma, often pubescent between the nerves; anthers purplish, 0.6-0.8 mm. long; caryopsis broadly fusiform, light brown, ca. 1.2-1.4 mm. long. Chromosome number $2n = 22$.

The above description was quoted from the description of *Parodiella erectifolia*, since our specimens are too weathered to provide many details. This South American species has been collected only twice in North America, from the alpine páramo of Chirripó Grande. The specimens are: Prov. de San José, *Chusquea subtessellata* páramo, elevation 3,500 m., between Refugio and lake at head of Río Ditkebi, *G. Davidse 1562*, 3 April 1969; Chirripó-Massiv, Quellgebiet des Río Talari, "Valle de los Conejos," chusqueafreie Vegetationsflächen des Talbodens, Kaltluftsee, ca. 3,500 m., 16 March 1971, *Kuhbier 0401*. Páramos, 3,400-4,200 m.; Venezuela, Colombia, Peru; southern Costa Rica.

LUZIOLA Jussieu ex Gmelin

REFERENCE: J. R. Swallen, The grass genus *Luziola*, Ann. Missouri Bot. Gard. 52:472-75. 1965.

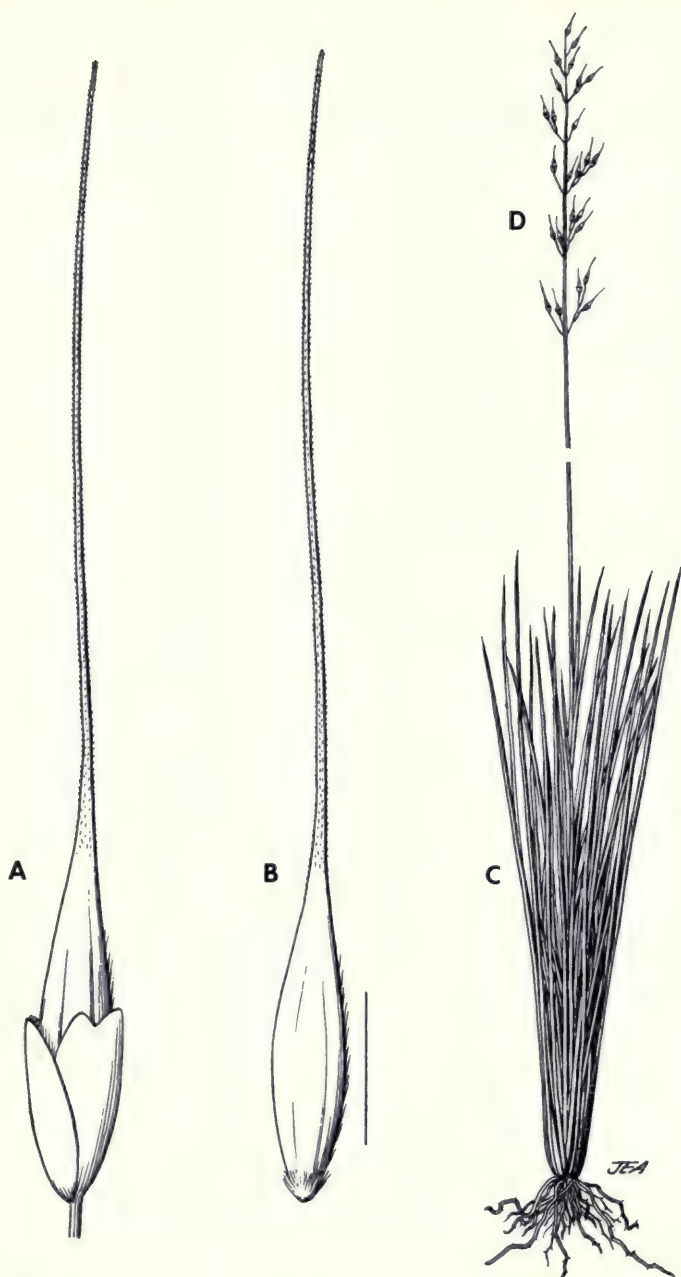


FIG. 114. *Lorenzochloa erectifolia*. A, spikelet; B, floret; C, portion of a plant with rigid basal leaves; D, inflorescence.

Monoecious aquatic or paludose grasses; spikelets unisexual, in usually separate inflorescences, the pistillate inflorescence an axillary panicle (reduced to 2 conjugate racemes in *L. fragilis*), the staminate a terminal panicle or raceme; glumes reduced to a minute cupule or absent; floret single, disarticulating from the cupule or pedicel apex; pistillate spikelets with equal, many-nerved lemma and palea; lodicules not functional, the stigmas laterally exerted from the lemma and palea; caryopsis ovoid or spherical, striate, crowned with the persistent style bases, retained within the floret, which usually decays into a circle of fibers attached to the caryopsis; staminate spikelets with thin, membranous, faintly-nerved lemma and palea; stamens 6. (Oryzoideae: Oryzeae.)

KEY TO SPECIES OF *Luziola*

- 1a. Pistillate inflorescence a single pair of few-flowered reflexed racemes at tip of peduncle; staminate inflorescence a simple raceme; culms weak, leafless, submerged in water, foliage leaves floating on water surface *L. fragilis*
- 1b. Pistillate and staminate inflorescences panicles with several to many branches; culms ascending or erect, stiff, leafy *L. subintegra*

Luziola fragilis Swallen, Ann. Missouri Bot. Gard. 52:474. 1965.
Figure 115.

Aquatic; duration indefinite; culms weak and slender, rooted in soil of ponds; submerged internodes with thin membranaceous, bladeless sheaths; foliage leaves floating on top of the water during wet seasons; plants forming dense mats of foliage on drying mud during dry seasons; internodes of submerged culms up to 11 cm. long, the internodes of the floating portions very short, frequently less than 1 cm. long; nodes slightly bearded; culms less than 1 mm. thick, apparently solid. Floating foliage: Sheaths ca. 2 cm. long, densely villous, or the uppermost sparsely so; ligules membranaceous, white, 1-2 mm. long; blades 3-6 cm. long, 2-2.5 mm. wide, strongly ridged above, the ridges densely covered with minute thick blunt spicules; usually 3-4 floating leaves at the tip of the culm; branching abundant just below the water surface; plants monoecious. Staminate inflorescence a simple terminal raceme of 3-5 spikelets which are appressed to the rachis; raceme borne on a slender, erect, intravaginal peduncle, exerted ca. 1 cm. from the mouth of the sheath; pedicels ca. 0.5 mm. long. Glumes lacking; floret 5-7 mm. long; lemma and palea very thin and membranaceous, the lemma ca. 7-nerved, the palea ca. 4-nerved, both with abundant blunt tricellular microhairs; stamens 6, the anthers yellow, 3-4 mm. long. Pistillate inflorescences axillary, from 1 or more nodes below the terminal staminate inflorescence; peduncle mostly included in the sheath, up to 3 cm. long; branches 2, bijugate at the apex of the peduncle and strongly reflexed in fruit, one usually slightly longer than the other; pedicels 0.5 mm. long, appressed to the branches. Spikelets 1-9 per branch, 1.8-2.3 mm. long, lanceolate at anthesis, becoming ovoid in fruit; glumes absent; lemma stramineous, broader than the palea and enveloping its base, with ca. 12-14 nerves; internerve tissue very thin, rotting away after maturity, the caryopsis remaining surrounded by the vascular bundles; palea ca. 6-nerved, similar to the lemma but narrower; caryopsis broadly ellipsoidal, brown, longitudinally striate, ca. 2 mm. long, crowned with the persistent style bases. Chromosome number $n = 12$ from a Costa Rican specimen.

This unusual aquatic grass closely resembles *Hydrochloa caroliniensis* in general aspect and ecology, but differs in the bijugate pistillate inflorescence. We have found it in permanent ponds near

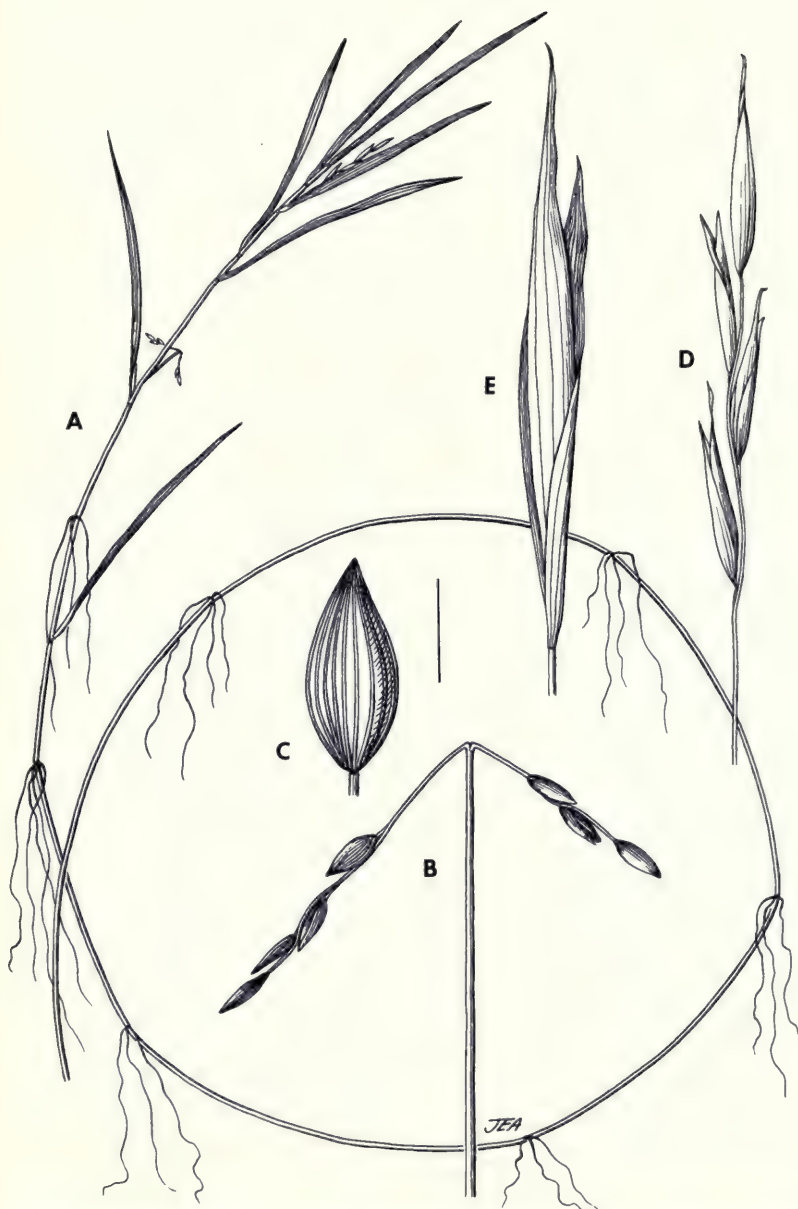


FIG. 115. *Luziola fragilis*. A, floating culm with inflorescences; B, pistillate inflorescence; C, pistillate spikelets; D, staminate inflorescence; E, staminate spikelet.

Buenos Aires, Prov. de Puntarenas, and in several similar ponds in Guanacaste, as at Laguna la Calavera. Another colony occurs on the road to Hacienda Los Inocentes. Blooming has been observed in December and January. Examination of dried pond bottoms later in the year showed extensive growth of turfy colonies of the plant, but no sign of flowering. I have been able to germinate seed, but the seedlings died.

This species has previously been known only from the type collection, from Aquidauana, Mato Grosso, Brazil. Although large gaps are common in the distribution patterns of aquatic grasses, it seems likely that *L. fragilis* will eventually be found in intermediate localities. The plants seem to require standing water that is permanent or nearly so. Finding the plants in such very scattered localities suggests that the seeds are transported by water fowl.

Luziola subintegra Swallen, Ann. Missouri Bot. Gard. 30:165. 1943. Figure 116.

Duration indefinite; plants sprawling and stoloniferous on wet, muddy soil, branching abundantly from the rooted nodes of the thick, spongy stolons; culms ascending, 2-4 mm. thick, hollow, glabrous and shining; nodes glabrous, conspicuous, brownish; prophylla many-nerved, 3-6 cm. long; leaf sheaths mostly longer than the culm internodes, overlapping, somewhat inflated; ligules membranaceous, usually 3-4 cm. long, acuminate to a fine point, adnate to the erect sheath auricles; blades stiffish, up to 35 cm. long, 12 mm. wide near the middle and tapering to a base narrower than the sheath apex. Pistillate inflorescences: 1-several, borne at successive lower nodes of the culms; peduncle short, fleshy, strongly bent and emerging extravaginally from the overlapping edges of the sheath just above the node; length ca. 4 cm. and broader than long; branches crowded, several per node; rachis soft, fleshy, angular; branches stiff, fleshy, strongly retrorse at maturity; pulvini prominent, ciliate at their edges. Spikelets appressed to the main branches, or 1 or more on a secondary branch, more or less terete, 5-5.5 mm. long; glumes reduced to a minute cupule; disarticulation above the cupule; lemma and palea equal, lanceolate, blunt; lemma 7-nerved, the nerves prominent, nearly contiguous when the spikelet is immature, spreading when distended with the fruit; nerves scabrid; palea similar to the lemma, 5-nerved; caryopsis ovoid, olivaceous, shining, slightly striate, tipped with the persistent bases of the styles, 1.5-2 mm. long at maturity, remaining within the floret; mature spikelet ovoid, tapering to a narrow apical beak; internerve tissue not disintegrating. Staminate inflorescence: Single, terminal on the culm, up to 7 cm. long, narrowly ovoid, with strongly ascending subverticillate branches. Spikelets racemose along the panicle branches, more or less terete, narrowly ovoid in outline, 5-6 mm. long; glumes reduced to a minute cupule; floret disarticulating above the cupule; lemma and palea equal, thin, white, membranaceous, faintly 5-nerved; stamens 6, the filaments very short, less than 1 mm. long; anthers 3.5-4 mm. long, sulfur yellow to reddish.

Rare; wet meadows and sand bars, at sea level; Las Playitas del Río Bebedero and Barro de Colorado. Blooming in December and January. El Salvador to Ecuador, Brazil, and Paraguay; Caribbean Islands.



FIG. 116. *Luziola subintegra*. A, staminate inflorescence; B, staminate spikelet; C, culm with axillary pistillate inflorescence; D, pistillate spikelet.

MELINIS Beauvois

Plants sprawling, leafy, the foliage densely viscid-hairy and strongly aromatic; inflorescence a panicle; spikelets somewhat laterally compressed, oblong in outline, disarticulating below the glumes; first glume minute, nerveless; second glume and sterile lemma subequal, lanceolate, strongly ribbed, both bifid at the tip; second glume 7-nerved, with a minute awn arising between the lobes; sterile lemma 3-5-nerved, with an elongated awn arising between the lobes; palea absent; fertile floret shorter than the sterile lemma; its lemma and palea subequal, smooth and shining, thin and translucent; lemma ovate, 1-nerved. (Panicoideae: Paniceae.)

Melinis minutiflora Beauv., Ess. Nouv. Agrost. 54. 1812. Figure 117.

Sprawling perennial; culms decumbent and often rooting near the base, up to 180 cm. long but usually much shorter, much branched, with erect flowering branches; culms solid, pithy, papillose-pilose with spreading hairs; nodes bearded with appressed erect hairs; sheaths, except the upper ones, mostly overlapping, densely papillose-pilose, the hairs with viscid blobs of odorous resinous material; ligule a dense arc of silky white hairs, ca. 1 mm. long; blades velvety on both surfaces, papillose-ciliate on the margins, 5-15 cm. long, 5-12 mm. wide, flat; peduncle glabrous, 4-10 cm. long; panicles terminal on leafy branches, 9-22 cm. long, 2-7 cm. wide, purple, narrow, the branches spreading only during anthesis, delicate, densely flowered; spikelets slightly laterally compressed, 1.9-2.5 mm. long; first glume rotund, 0.2-0.3 mm. long; second glume lanceolate, 5-7-nerved, 1.9-2.5 mm. long; sterile lemma similar to the second glume, 1.8-2.4 mm. long, 3-5-nerved, the awn 5-12 mm. long; fertile floret 1.7-2.0 mm. long, the lemma and palea about equal or the palea slightly longer; anthers 3, 1-1.5 mm. long, purple. Chromosome number $n = 18$.

Roadsides and pastures, especially in the Meseta Central and General Valley; 700-1,900 m. elevation. This species blooms *en masse* during the short days of November and December, but small amounts of bloom may be seen at other times of the year. This species is of African origin, but has become widely distributed in the American tropics through its use as a forage grass. It is popularly believed that *Melinis* traps ticks by its stickiness and repels mosquitoes by its strong odor. Common names: "Molasses grass," *Gordura*, *Calinguero*.

MEROSTACHYS Sprengel

Caespitose, nonthorny bamboos; rhizomes pachymorphous; internodes cylindrical, hollow; culm sheaths with a narrow, reflexed blade; leaf-bearing branches equal, fascicled, arising from the margins of a flat, platelike meristem adnate to the base of the internode. Inflorescence a one-sided, rather dense spike, the spikelets solitary or paired, in 2 rows along the lower side of the rachis. Glumes usually rudimentary or absent; sterile lemmas 2; fertile florets 1-several, the rachilla prolonged beyond the fertile florets and bearing a rudimentary floret at its apex; disarticulation below the fertile floret; palea grooved, the keels clasping the rachilla internode; lodicules 3, flat, vasculated; anthers 3; stigmas 2. (Bambusoideae: Arthrostylideae.)

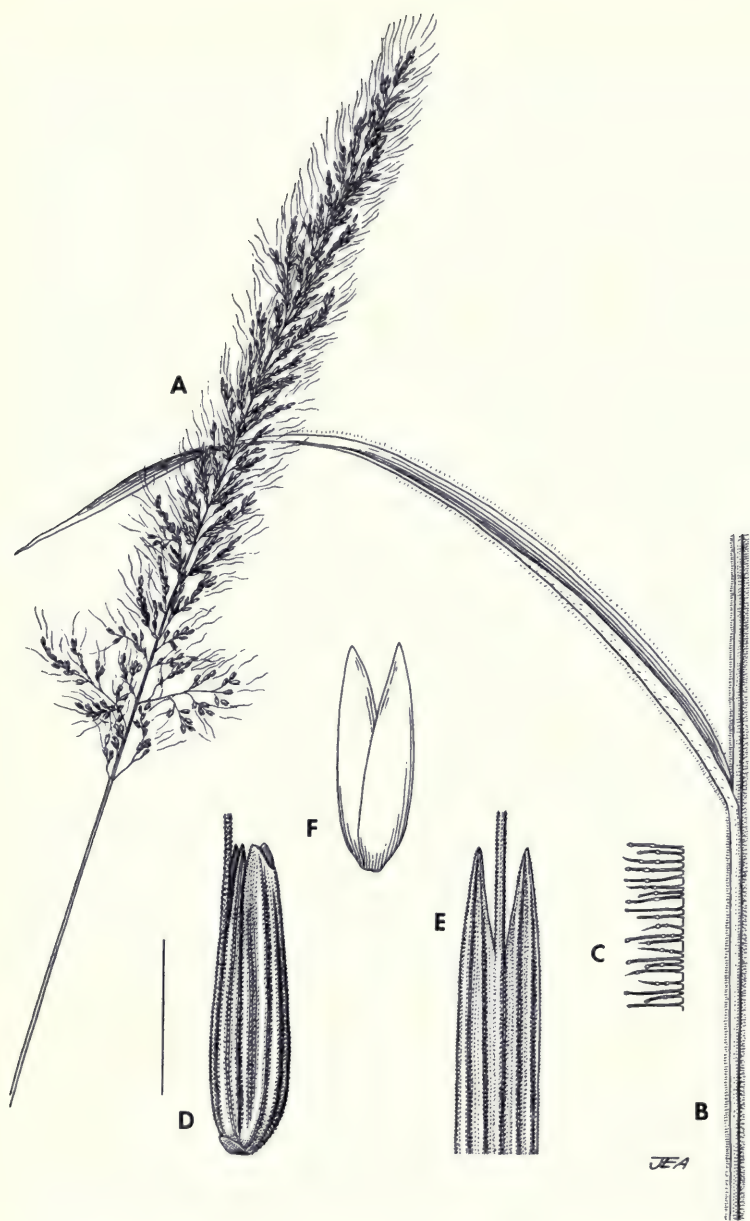


FIG. 117. *Melinis minutiflora*. A, panicle; B, culm internode and leaf; C, hairs with sticky globules; D, spikelet; E, apex of sterile lemma; F, fertile floret.

This genus is known in Costa Rica by two flowering specimens. They are too fragmentary for specific determination, although *M. multiramea* Hack. has been reported from La Palma de San Ramón by Standley on the basis of a specimen in the National Museum of Costa Rica.

Merostachys sp. indet. Figure 118.

Specimens fragmentary, represented by fascicles of up to 10 flowering branchlets, these up to 60 cm. long, including the inflorescences; internodes cylindrical, up to 8 mm. thick, glabrous; leaves with blades 4-7, borne on the outer portion of the branchlets; lower internodes glabrous, naked or with bladeless sheaths; apex of internodes finely appressed-silky; sheaths glabrous; auricular bristles conspicuous, 7-12 mm. long; ligule a short, thick, minutely ciliolate membrane, ca. 0.5 mm. long; blades flat, ovate 6-9:1, acuminate, the base rounded to a pseudopetiole ca. 4 mm. long; blade surfaces glabrous, the marginal nerves finely scabrous. Inflorescences terminal on leafy branchlets; spikes falcate, one-sided, 4.5-6.5 cm. long, ca. 1 cm. wide; peduncle and rachis finely white-silky; spikelets mostly paired and sessile, one each side of the rachis. Spikelets 11-13 mm. long, falcate, crowded, brown or purplish; disarticulation above the 2 basal bracts (glumes or sterile lemmas); first bract triangular 2.5:1, acute, 1-3-nerved; second bract ovate ca. 2.5:1, acute, 7-nerved, rounded on the back, acute, the margins ciliolate near the tip; fertile lemma 9.5-10 mm. long, 11-nerved, the margins overlapping at the base; surface sparsely pubescent; palea slightly longer, broad, 10-nerved, the 2 ciliolate keels close together, clasping a flattened slender rachilla, ca. 8 mm. long, with a minute rudiment at its tip; lodicules 3, flat; anthers not seen.

This species is represented in the Field Museum Herbarium by the following flowering specimens from Costa Rica. I have not seen other specimens from the country. Prov. Puntarenas, Zapotel, Montes de Oro, altitude 1,500 m., May 1961, *Otón Jiménez s.n.*; Prov. Alajuela, La Palma de San Ramón, altitude 1,050 m., 17 April 1927, *Brenes 5433*. Common names are given as *Canuela* or *Carrizo*, but these names are rather widely applied to different plants.

MESOSETUM Steudel

REFERENCE: J. R. Swallen, The grass genus *Mesosetum*, Brittonia 2:363-392. 1937.

Caespitose or stoloniferous grasses; inflorescence a solitary terminal dorsiventral spike or spike-like raceme, the spikelets solitary, erect, appressed to the flattened rachis, alternating in 2 rows along one side of it, with the first glumes placed toward the midrib. Spikelets laterally compressed, the glumes subequal, stiff, nearly as long as the sterile lower lemma, folded and sometimes wing-keeled near the tips; first glume 3-nerved; second glume 5-nerved; lower lemma usually lacking a flower, its palea well developed; upper floret shorter than the lower, with a perfect flower, its lemma coriaceous, boat-shaped, 5-nerved, the margins not inrolled, the tip tapering into a narrow blunt beak; palea of similar texture, broad, infolding the flower, convex on the back.



FIG. 118. *Merostachys* species. A, branch complement, showing one flowering branch; B, pair of spikelets; C, terminal floret, showing elongated rachilla internode with a terminal rudiment.

A small genus of about 30 species, mostly in South America, a few in the West Indies and Central America. The genus is related to *Echinolaena* and *Eriochloa*. (Panicoideae: Paniceae.)

Mesosetum pittieri Hitchc., Proc. Biol. Soc. Wash. 40:85. 1927. Figure 119.

Duration indefinite; culms 15-40 cm. long, erect or trailing and rooting at the lower nodes, unbranched; culms glabrous, hollow, ca. 1 mm. thick; foliage mostly near the bases of the culms, the upper 1 or 2 leaf blades much reduced; sheaths somewhat keeled, the lower ones pubescent, the upper glabrous except for the papillose-ciliate margins; ligule a dense row of stiff short hairs, 0.2-0.5 mm. long; leaf blades 3-4 per culm, the uppermost much reduced; blades stiff, the larger ones 5-9 cm. long, 3-5 mm. wide, with a thick white marginal band, papillose-pilose above and below or nearly glabrous. Peduncle included in the upper sheath or exerted up to 7 cm., slender, stiff, glabrous; spike 3-7 cm. long, linear, 3-5 mm. wide, the rachis slightly zigzag, ca. 1 mm. wide, flattened, with a prominent midrib. Spikelets laterally compressed, the flat sides appressed to the rachis; outline V-shaped, the base narrowed into a short narrow stipe ca. 0.5 mm. long enveloped by the bases of the glumes; length of spikelet, including the stipe, 5.5-6.2 mm.; first glume 4.9-5.5 mm. long, oblong-spatulate, winged at the obtuse tip, silky along the keel near the base, scabrid above; second glume and sterile (lower) lemma subequal, 5.5-6.2 mm. long, both green-mottled and cross-wrinkled near the tip; second glume narrowly ovate, slightly winged at the tip, silky along the keel and margins; sterile lemma narrowly oblong, blunt and slightly winged at the tip, silky between the lateral nerves on the lower half and on the margins near the middle, a conspicuous tuft of hairs on the keel one-third below the tip; palea of sterile lemma linear, nearly as long as the lemma; fertile floret 4.7-4.8 mm. long, stramineous, minutely roughened; anthers 3, ca. 2 mm. long, purple; caryopsis obovate, tan, the embryo prominent, ca. half the length of the grain; opposite side of the caryopsis with a dark line running its entire length. Chromosome number $n = 8$.

We have collected this species in *Byrsonima-Curatella* savannas of Hacienda Murcielago and Hda. Las Ánimas. In both cases, the plants were growing in slightly moist depressions. Elevations 200-300 m. Late July, December. This species was previously known only from the type locality, near Chepo, Panama and from San Lorenzo, Honduras.

MUHLENBERGIA Schreber

REFERENCES: T. R. Soderstrom, Taxonomic study of subgenus *Podosemum* and section *Epicampes* of *Muhlenbergia* (Gramineae), Contr. U.S. Natl. Herb. 34:75-189 + pl. 1-14. 1967. J. R. Swallen, The awnless annual species of *Muhlenbergia*, Contr. U.S. Natl. Herb. 29:203-208. 1947.

Caespitose or rhizomatous annual or perennial grasses; ligules membranaceous, often ciliate; inflorescence an open or contracted panicle; spikelets 1-flowered, disarticulating above the glumes, laterally compressed or terete; glumes shorter than or equal to the lemma, 1-3-nerved, or nerveless if minute, the first usually smaller than the second;



FIG. 119. *Mesosetum pittieri*. A, blooming plant; B, inflorescence; C, spikelet.

lemma slender, 3 (-5)-nerved, membranaceous, rounded on the back, tapering to a point, usually awned, rarely with minute teeth at the base of the awn; callus short, usually bearded; palea about equal to the lemma, 2-nerved. (Chloridoideae: Sporoboleae.) The basic chromosome number in *Muhlenbergia* is consistently $x = 10$, whereas that of *Sporobolus* is $x = 9$ or $x = 6$.

A genus of about 100 species, mostly of North America, some species in South America and a few in temperate Asia. *Muhlenbergia* is similar to *Sporobolus*, differing in the 3-nerved lemma and usual possession of lemma awns, and in the adherent pericarp. Awnless species have sometimes been transferred from one genus to the other.

KEY TO SPECIES OF *Muhlenbergia*

- 1a. Spikelets awnless or the lemmas with short awns less than 1 mm. long 2
- 1b. Spikelets awned, awn longer than lemma 4
 - 2a. Dwarf, much-branched perennials, less than 20 cm. tall 3
 - 2b. Culms erect, unbranched, 70-100 cm. tall *M. nigra*
- 3a. Panicles exserted, many-flowered *M. ramulosa*
- 3b. Panicles hidden in the densely fascicled leaves, with 3-7 spikelets; páramos of Chirripó Grande *M. calcicola*
 - 4a. Plants 70-170 cm. tall; culms unbranched; leaf blades 40-70 cm. long; inflorescence 20-40 cm. long *M. lehmanniana*
 - 4b. Plants much shorter or culms branched; leaf blades less than 15 cm. long; inflorescences less than 15 cm. long 5
- 5a. Ligules 1.5-8.0 mm. long (usually over 2.0 mm.) 6
- 5b. Ligules less than 1.2 mm. long 8
 - 6a. Glumes minute, less than 0.5 mm. long, rounded, nerveless; panicles open and delicate, spikelets on diverging pedicels longer than the spikelets
M. implicata
 - 6b. Glumes more than 1 mm. long, 1-3-nerved; panicles narrow or congested, spikelets short-pedicellate 7
- 7a. Leaves mostly basal, sheaths strongly keeled, forming fan-shaped tufts, only one small blade at midculm; second glume 3-nerved, obtuse or 3-lobed at apex; páramos over 3,000 m. *M. flabellata*
- 7b. Leaves distributed along the culms; glumes acuminate, 1-nerved; moist forests, 1,500-2,100 m. *M. setarioides*
 - 8a. Glumes of all spikelets similar 9
 - 8b. One glume of terminal spikelet on inflorescence branches awned, others obtuse, nerveless *M. diversiglumis*
- 9a. Ligules 0.8-1.2 mm. long; panicles very open; pedicels very slender, divergent, longer than spikelets *M. tenuissima*
- 9b. Ligules less than 0.5 mm. long; spikelets short-pedicellate, appressed to rachis or branches of rather condensed panicles 10
 - 10a. Lemmas ciliate; primary panicle branches spreading *M. ciliata*
 - 10b. Lemmas not ciliate; primary panicle branches appressed to rachis
M. tenella

Muhlenbergia calcicola Swallen, Contr. U.S. Natl. Herb. 29:407. 1950. Figure 122.

Perennial, forming flat tufts up to 15 cm. broad, dying in the center; plants 3-4 cm. tall, densely crowded; culms branching profusely, their internodes only 2-5 mm. long, a short branchlet with fascicled leaves borne at each node; culms 0.5 mm. thick, solid; prophylla 3.5-4.0 mm. long, broad; sheaths glabrous, ridged, flattened by the densely fascicled branches and leaves within; ligule a membrane 0.7-0.9 mm. long; blades 3-14 mm. long, 1.0-1.5 mm. wide, thick and stiff, flat or folded, ridged on both surfaces, tapering abruptly to a boat-shaped tip; the midrib prominent beneath; upper surface bearing minute erect spicular hairs. Inflorescence a few (3-7) flowered raceme or simple panicle, concealed in the upper sheaths, or barely exserted; pedicels stiff, thick, erect, scabrous. Spikelets blackish; glumes ovate, acute, the first 1-nerved, 1.4-1.7 mm. long, the second sometimes 3-nerved, 1.7-1.9 mm. long; lemma ovate, somewhat keeled, 3-nerved, 2.5-3.0 mm. long; callus truncate, glabrous; lemma tapering to a short, thick, scabrous awn up to 1.0 mm. long; palea flat between the keels, equal to the lemma; caryopsis cylindrical, ca. 1 mm. long.

Known in Costa Rica only from the Valle de Conejos, Chirripó Grande, at elevations between 3,400 and 3,800 m. The plants formed large mats or tufts in flat moist depressions. November to January. Previously known only from the highlands of northwestern Guatemala. *Muhlenbergia breviculmis* Swallen is doubtfully distinct from *M. calcicola*, the specimens probably representing young plants of the latter.

Muhlenbergia ciliata (H.B.K.) Kunth, Rév. Gram. 1:63. 1829. *Podosaemum ciliatum* H.B.K., Nov. Gen. & Sp. 1:128. 1816. Figure 120.

Sprawling, delicate, short-lived annual; tufted; culms slender, 15-25 cm. long, 0.3 mm. thick, glabrous, branching freely from the lower and middle nodes; prophylla 5-8 mm. long; sheaths and blades hispid or nearly glabrous; sheaths much shorter than the internodes; ligule a lacerate membrane, ca. 0.3 mm. long; blades reflexed, mostly folded or involute, 1.5-3.0 cm. long, 1-2 mm. wide. Inflorescences numerous, terminal on the main culm or on leafy branches; panicles 5-9 cm. long, the slender exposed axis bearing 5-8 slender spreading or reflexed solitary branches, each 1-2 cm. long; spikelets appressed to the branches, overlapping. Spikelets 2-3 mm. long, excluding the awns; first glume linear to lanceolate, 1-nerved, 0.7-1.2 mm. long, the midnerve often excurrent as a short awn; second glume similar, 1.2-1.7 mm. long; lemma slender, lanceolate, strongly 3-nerved, 2.1-3.0 mm. long, the callus minutely bearded; marginal nerves more or less papillose-ciliate, sometimes nearly glabrous; awn slender, flexuous, 7-17 mm. long; palea equal to the lemma; anthers 3, yellow, ca. 0.3 mm. long. Some descriptions state that the lemmas are 5-nerved. Examination with the microscope shows that the supposed intermediate nerves are not vascular bundles, but merely rows of short barbs.

Moist rocky banks and roadsides. Our only Costa Rican specimen was collected along the CIA, 14 km. S of División, at 1,500 m. elevation. December. Mexico to Panama.

Muhlenbergia diversiglumis Trin., Mém. Acad. Imp. Sci. St.-

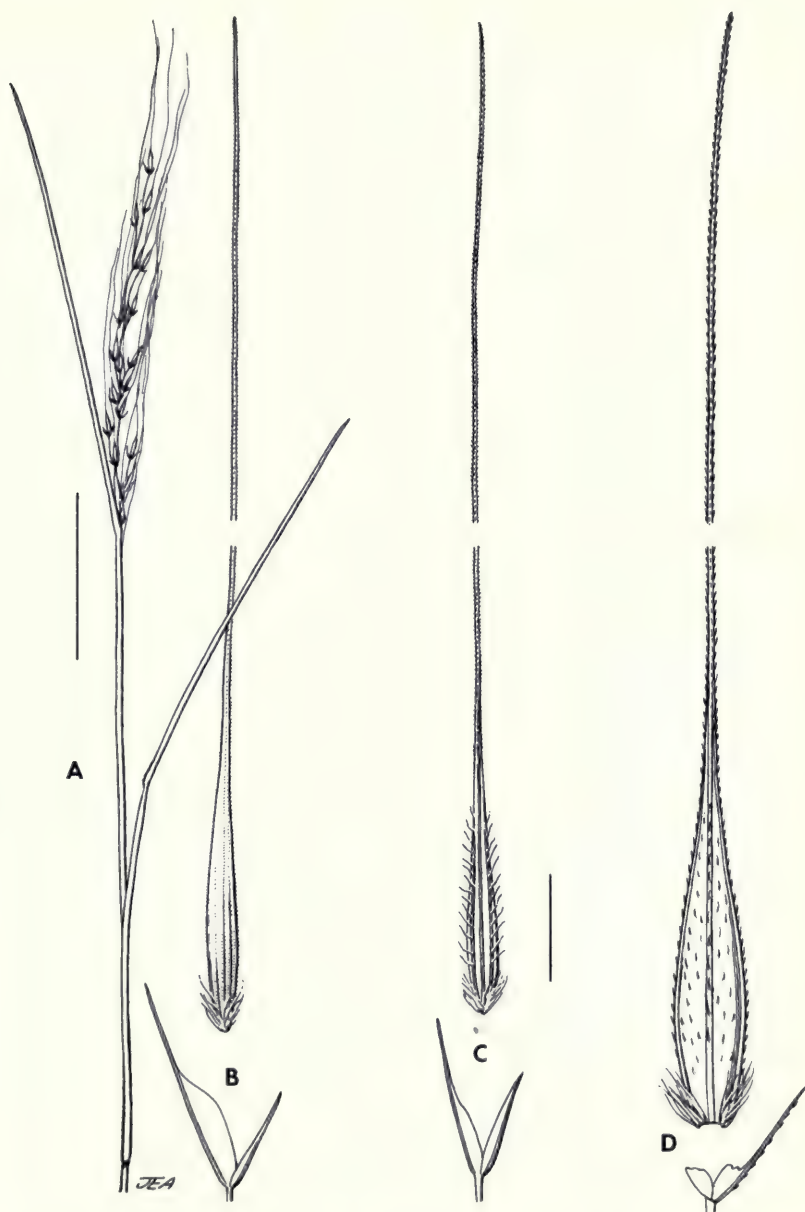


FIG. 120. *Muhlenbergia* species. *M. tenella*: A, inflorescence; B, glumes and floret; *M. ciliata*: C, glumes and floret; *M. diversiglumis*: D, glumes and floret.

Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4:298. 1845. Figure 120.

Delicate short-lived annual; plants sprawling, the culms 25-60 cm. long, long-decumbent and rooting, with erect flowering branches arising from the decumbent portions; prophylla 8-10 mm. long; culms slender, 0.5-0.7 mm. thick, hollow, thin-walled, glabrous; nodes retrorsely bearded; foliage glabrous to papillose-hirsute; sheaths mostly shorter than the internodes; ligule a rather prominent membrane, 0.7 mm. long; blades flat, thin, 2-6 cm. long, 1.5-2 mm. wide. Inflorescences terminal on erect branches of the culms, open cylindrical, 5-12 cm. long, the numerous short, slender spreading or drooping branches borne racemously along the slender rachis, mostly directed to one side; basal portion of each branch forming a weak, often contorted, hispid stipe, the branches disarticulating from the rachis when mature; lowermost branches with several distant appressed spikelets, the upper ones mostly with 2 spikelets. Spikelets dimorphic; lower spikelets of each branch with 2 subequal minute orbicular 1-nerved glumes, ca. 0.2-0.3 mm. long; terminal spikelet of each branch with an awned second glume, the awn from 1-6 mm. long; lemma lanceolate, 3.5-4.2 mm. long, strongly 3-nerved, the internerves white, the nerves green, extending into short teeth on either side of the awn; callus minutely bearded; awn usually purple, flexuous, 7-10 cm. long; palea equal to the lemma or slightly longer, prominent, the nerves prominent, green, approaching near the narrowed tip and excurrent as minute awn-tips; anthers 3, yellow-orange, 0.4-0.6 mm. long.

Meseta Central and Cantón de Dota; Zarcero; roadsides and ditches, 1,100-2,000 m. elevation; late November to January. Southern Mexico to Panama.

Mexican specimens of this species are more robust than ours and have longer awns on the second glumes of the terminal spikelets. The plants are similar to *M. tenella* and *M. ciliata*.

Muhlenbergia flabellata Mez, Repert. Sp. Nov. 17:213. 1921. Figure 121.

Perennial; plants sprawling, forming large clumps, the culms 25-45 cm. long; lower parts of the culms reclining and branching profusely from the lower nodes; foliage mostly clustered on the lower portions of the plants, the sheaths much overlapping; a single small leaf borne at midculm; culms thin, rigid, the interior filled with vascular bundles imbedded in sclerenchyma; lower sheaths becoming flattened and papery with age; ligule an erect pointed membrane, 2.5-8.0 mm. long, decurrent on the sheath margins; blades 2-4 cm. long, strongly ridged and puberulent above, mostly involute. Peduncle slender, stiff, ridged, scabrid, up to 18 cm. long; inflorescence solitary, terminal, a slender few-flowered panicle, 3-9 cm. long, the branches erect; axis and branches scabrous; spikelets short-pedicellate, appressed to the branches. Spikelets blackish, 3-4 mm. long, excluding the awn; first glume ovate, blunt, 1-nerved, 1.2-1.6 mm. long; second glume oblong-obovate, 3-nerved, truncate or 3-lobed at the apex, the slightly scabrid nerves parallel, ending in the lobes; floret 3-4 mm. long; lemma lanceolate, rounded on the back, with a truncate callus, firm, 3-nerved; callus short-bearded; margins of lemma and lower back appressed-pubescent, the tip scabrid; awn stiff, scabrous, flexuous, arising from the tip of the lemma, 4.0-7.5 mm. long; palea equal to the lemma; anthers 3, purple, 1.8-2.1 mm. long.



FIG. 121. *Muhlenbergia flabellata*. A, blooming plant; B, glumes; C, floret.

Páramos of Cerro Buena Vista (type locality); Chirripó Grande; elevations 3,300-3,500 m. Blooming sparse, but apparently yearlong. Endemic to Costa Rica.

This species is listed as *M. quadridentata* (H.B.K.) Kunth by Hitchcock in *Grasses of Central America*; however, that is a distinct species and is not found in Costa Rica.

Muhlenbergia implicata (H.B.K.) Kunth, Rév. Gram. 1:63. 1829. *Podosaemum implicatum* H.B.K., Nov. Gen. & Sp. 1:127. 1816.

Sprawling tufted annual plants, the culms mostly 30-50 cm. long, the lower portions decumbent and rooting, the numerous branches erect and bearing terminal inflorescences; prophylla 10-25 mm. long; culms ca. 0.5 mm. thick, hollow, angular, the upper portions of the internodes minutely retrorsely puberulent; nodes dark, contracted, glabrous; sheaths mostly longer than the internodes but rather loose, keeled near the apex, glabrous; ligule a firm, pointed membrane, 2.0-3.0 mm. long; blades mostly folded, 4-8 cm. long, 1.0-1.4 mm. wide, puberulent above. Peduncle included; inflorescences terminal on the main culms or on leafy branches; panicles open, delicate, ovoid, 5-15 cm. long, 4-8 cm. wide; spikelets long-pedicellate, the pedicels filiform, flexuous, diverging strongly from the branches, thickened just below the spikelet. Spikelets mostly purplish, 2.8-3.2 mm. long; glumes rotund, nerveless, minute, the first 0.2-0.3 mm. long, the second 0.4-0.5 mm. long; lemma 2.8-3.2 mm. long, narrowly lanceolate, 3-nerved, the lateral nerves close to the midrib, scabrous; 2 extra rows of barbs, simulating nerves, also present; tip of lemma bearing 2 minute slender teeth at the base of the awn; callus minutely bearded; awn slender, 12-20 mm. long; palea equal to the lemma; anthers 3, purple, 0.4-0.7 mm. long. Chromosome number $n = 10$ from a Costa Rican specimen.

Dry, rocky roadsides, Meseta Central and Cantón de Dota; San Isidro area; elevations 1,100-1,800 m.; October to April. Mexico to Venezuela and Colombia.

This species is similar in general appearance to *M. tenuissima*, but differs in its larger spikelets, blunt glumes, and nonciliate lemmas.

Muhlenbergia lehmanniana Henr., Med. Rijksherb. Leiden 40:59. 1921. *M. attenuata* Swallen, Fl. Panama, Ann. Missouri Bot. Gard. 30:138. 1943.

Vigorous perennial, caespitose in large, dense clumps; culms arching, 70-170 cm. long, unbranched, 2 mm. thick, hollow, glabrous, with 3-4 nodes above the base; foliage mostly basal, the lower sheaths strongly keeled and densely overlapping, forming fan-shaped clusters, their blades often disarticulating; culm sheaths mostly longer than the internodes; blades mostly 60 cm. or more long, 1-4 mm. wide, harsh and scabrous, folded, tapering to elongated threadlike points; the midrib prominently keeled. Inflorescence a solitary terminal panicle, usually 20-40 cm. long, oblong-ovoid, open and up to 10 cm. wide when the branches spread at flowering time, later dense and contracted, 2-3 cm. wide; color rosy or purplish when young, brownish later; spikelets appressed along the slender branches. Spikelets 2.5-3.0 (3.5) mm. long; glumes subequal, usually longer than the floret, 1-nerved, lanceolate, scabrous on the keel and usually on the surface, blunt or slightly bifid at the apex, usually with a minute awn tip; lemma lanceolate, 2.4-3.0 mm.

long, rounded on the scabrous back, the lateral nerves slightly excurrent as minute teeth at the base of the awn; callus oblique, minutely bearded; awn slender, flexuous, scabrid, mostly 2-3 cm. long; palea equal to the lemma, glabrous between the evident nerves; anthers 3, purplish, 1.5-1.7 mm. long.

Occasional on steep rocky banks and road cuts, usually in full sun; Meseta Central; General Valley, Boruca, Cañas Gordas. November and December. Elevations from 400-2,000 m. Costa Rica, Panama, and Colombia.

This handsome species forms colonies on steep slopes. The plants are conspicuous when they bloom at the beginning of the dry season. It has usually been included in *M. emersleyi* Vasey (*Epicampes emersleyi* (Vasey) Hitchc.) in older publications.

Muhlenbergia minutissima (Steud.) Swallen was reported (as *Sporobolus minutissimus* (Steud.) Hitchc.) by Hitchcock in Gram. Cent. Amer. as occurring in Costa Rica. We have not found specimens in US or F to substantiate this report.

***Muhlenbergia nigra* Hitchc., N. Amer. Fl. 17:468. 1935.**

Densely caespitose harsh perennial; plants 90-100 cm. tall, erect; culms unbranched; internodes up to 3 mm. thick, hollow, minutely scabrous-puberulent, finely silky below the nodes; nodes dark, not prominent, glabrous; sheaths mostly overlapping, smooth, faintly scabrous; ligules decurrent on the sheath margins, wider than the blade base, firm and plainly vasculated near the base, white and membranaceous toward the apex, 7-20 mm. long, the apex pointed or lacerate; leaf blades involute, scaberulous, strongly ridged above, up to 25 cm. long, 2-3 mm. wide, tapering to a caudate-acuminate, scabrous tip. Peduncle cylindrical, exerted up to 30 cm., scabrous, especially toward the apex; inflorescences terminal on the culms; panicles densely cylindrical, 10-14 cm. long, 5-10 mm. thick, tapering to both ends, leaden gray; branches short, few-flowered, the spikelets borne on very short, minutely puberulent pedicels, densely overlapping and concealing the puberulent rachis. Spikelets narrow, 4-5 × longer than wide, 6.0-7.0 mm. long, strongly laterally compressed; bracts all scaberulous; glumes subequal, slightly longer than the floret, narrowly triangular 7:1 as folded, acuminate, 1-nerved, strongly keeled; floret 6.0-6.5 mm. long, ovate 6:1 as folded, acuminate or awn-tipped; 3-nerved; callus sparsely short-bearded; palea 2-nerved, slightly shorter than the lemma; anthers 2.5-3.0 mm. long, whitish; caryopsis linear-cylindric, red-brown.

This rare species was previously known only from southern Mexico and northern Guatemala. It occurs only at high altitudes. The only identifiable Costa Rican specimen is cited below. A previously collected specimen from the same site had completely smutted inflorescences. The current specimen is mostly smutted, but has one normal inflorescence. Prov. San José, Valle de los Conejos, elevation ca. 3,200 m., 5-13 November 1976, *R. A. Ocampo 1492* (CR, ISC).

***Muhlenbergia ramulosa* (H.B.K.) Swallen, Contr. U.S. Natl.**

Herb. 29:205. 1947. *Vilfa ramulosa* H.B.K., Nov. Gen & Sp. 1:137. 1816. *Sporobolus ramulosus* Kunth, Rév. Gram. 1:68. 1829. Figure 122.

Densely tufted annual, 5-15 cm. tall; culms decumbent at the base, upper portions erect; branching at all nodes; prophylla 6-8 mm. long; culms less than 0.5 mm. thick, solid, glabrous or puberulent below the nodes; sheaths mostly longer than the internodes, strongly ridged, glabrous; ligule a minute ciliate membrane, 0.3-0.5 mm. long; blades mostly folded, puberulent above, 1-2 cm. long, 0.6-0.8 mm. wide, narrowed to a blunt tip. Peduncle included; inflorescences numerous, terminal and axillary; terminal panicles 1-5 cm. long, open-cylindrical, up to 1 cm. wide; branches solitary, spreading, few-flowered; spikelets borne on stiff spreading pedicels about as long as the spikelet. Spikelets 1.0-1.2 mm. long; glumes about equal, rounded, nerveless, 0.4-0.6 mm. long; lemma ca. 1 mm. long, ovate, obscurely 3-nerved, blackish, glabrous, awnless; palea equal to lemma, convex on the back; both lemma and palea cartilaginous, smooth; palea occasionally with a few scattered hairs; anthers minute, ca. 0.2 mm. long, rounded. Many spikelets dwarfed or abortive. Chromosome number $n = 10$ from the Costa Rican specimen.

Cultivated field, San Juan de Chicoa, Irazú, at 2,600 m. elevation. November. An old Jimenez specimen (1151) was from the Crater of Irazú, the locality probably now destroyed. Southern Mexico to Costa Rica.

Muhlenbergia setarioides Fourn., Mex. Pl. 2:84. 1881. *M. polypogonoides* Hack., Ann. K. K. Naturhist. Hofmus. 17:255. 1902. Figure 123.

Sprawling perennial; culms up to 1 m. long, long-decumbent and rooting at the lower nodes; unbranched ascending flowering culms arising from the rooted portions; culms hollow, ca. 1.5 mm. thick, smooth and shining, glabrous; sheaths slightly keeled, glabrous, shorter or longer than the internodes; leaves numerous; ligule a lacerate-ciliate membrane, auricled, 1.5-3.5 mm. long; blades flat, lax, dark green, 4-12 cm. long, 4-9 mm. wide, slightly scabrid. Peduncle up to 6 cm. long; panicles terminal on the culm branches, 8-11 cm. long, 1.5-5 cm. wide, loosely cylindrical, interrupted below, the axis exposed; branches up to 3 cm. long, ascending, densely flowered to their bases; spikelets densely clustered on the branchlets, subsessile. Spikelets laterally compressed, 1-flowered, disarticulating above the glumes, 2.7-3.0 mm. long, excluding the awns; the bracts whitish with prominent green nerves; glumes 1-nerved, acute, keeled, lanceolate to narrowly ovate; first glume 1.1-1.5 mm. long, the second slightly broader, 1.5-2.1 mm. long; lemma 2.2-3.0 mm. long, prominently 3-nerved, lanceolate, rounded on the back, the short callus oblique and minutely bearded; lemma sparsely pilose on the lower third of the back, scabrid on and between the nerves; awn terminal, somewhat flexuous, 5-9 mm. long, purple; palea equal to the lemma, pilose between the keels on the lower half; anthers 3, 1.0-1.2 mm. long, yellow. Chromosome number $n = 20$ from a Costa Rican specimen.

Rare, moist shaded roadbanks, eastern Meseta Central, Irazú and Barba; elevations from 1,500 to 2,100 m.; blooming in February. Veracruz, Mexico; Guatemala and El Salvador; Costa Rica and Panama.

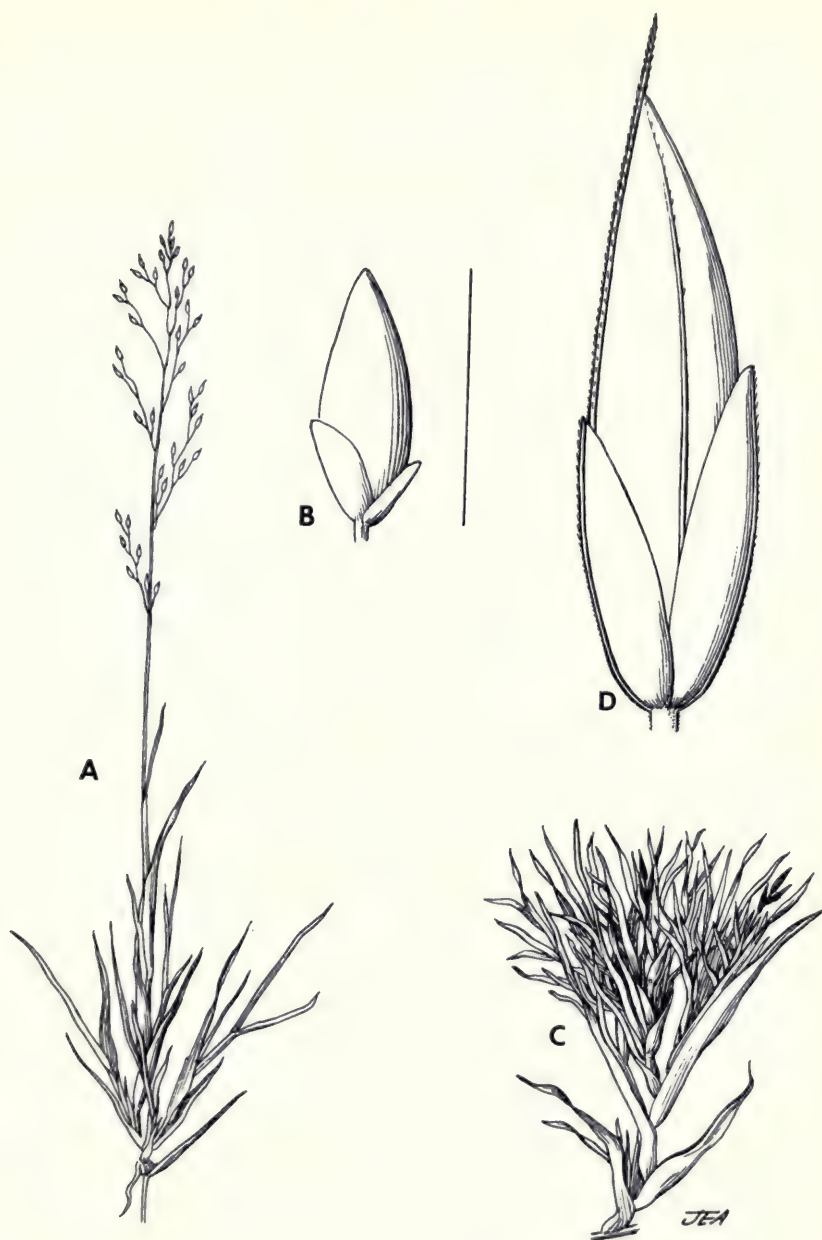


FIG. 122. *Muhlenbergia* species. *M. ramulosa*: A, blooming plant; B, spikelet; *M. calcicola*: C, blooming plant; D, spikelet.

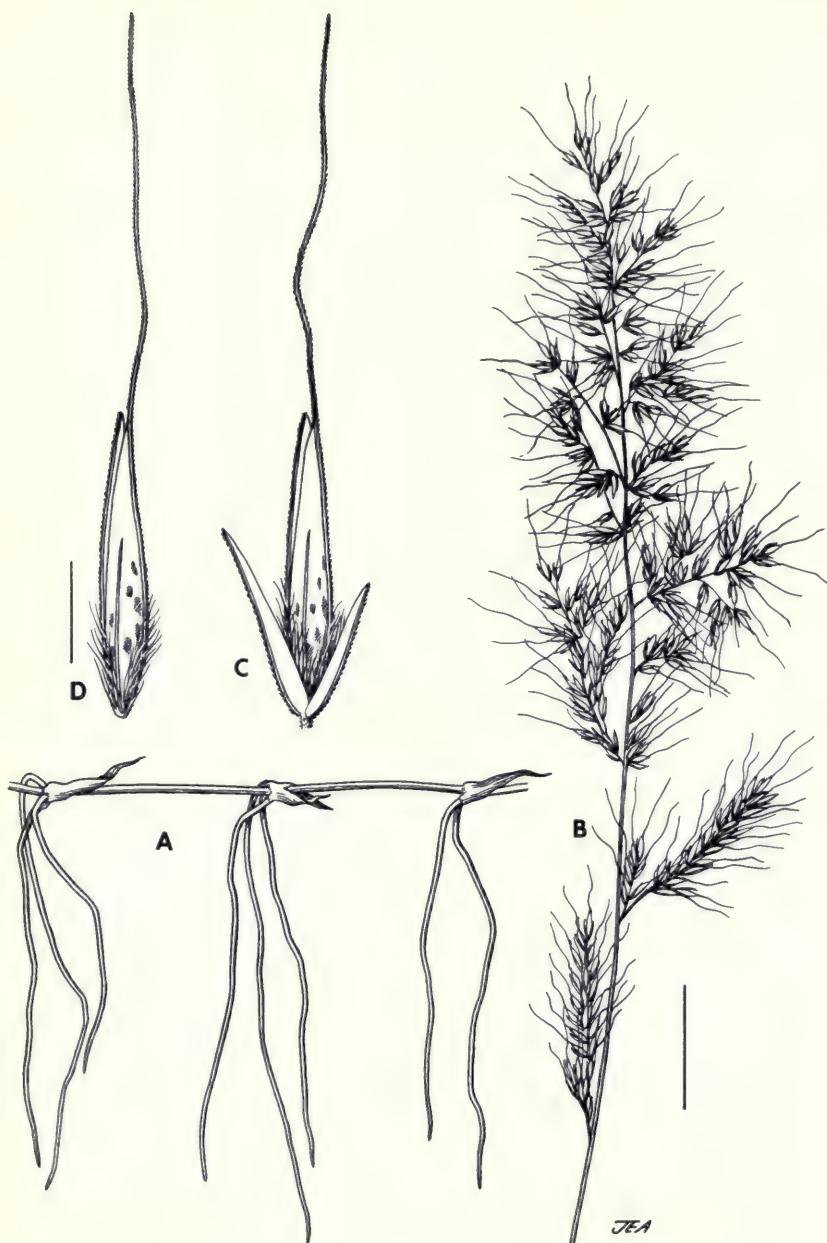


FIG. 123. *Muhlenbergia setarioides*. A, decumbent base of plant; B, panicle; C, spikelet; D, floret.

This species is in many ways similar to the rhizomatous mesophytic species of this genus common in temperate climates, such as *M. schreberi* and *M. frondosa*. It has no close relatives in Central America.

Muhlenbergia tenella (H.B.K.) Trin., Gram. Unifl. 192. 1824. *Podosaemum tenellum* H.B.K., Nov. Gen. & Sp. 1:128. 1816. *Trichochloa tenella* (H.B.K.), Roem. & Schult., Syst. Veg. 2:385. 1817. Trinius refers only to the Roemer & Schultes name, which is based in turn on *P. tenellum* H.B.K. Figure 120.

Short-lived annual; plants in small tufts, the culms erect or more commonly sprawling, 15-35 cm. long, branching freely from the lower and middle nodes; prophylla 8-10 mm. long; culms 0.2-0.3 mm. thick, hollow, glabrous; nodes glabrous; leaf sheaths shorter than the internodes, glabrous or sometimes hirsute, especially near the apex; ligule a minute lacerate membrane, ca. 0.3 mm. long; leaf blades flat, 2.0-3.5 cm. long, 0.8-2.0 mm. wide, from nearly glabrous to appressed-hirsute on one or both surfaces. Peduncle mostly included in the upper sheath; inflorescences numerous, terminal on the main culms or on leafy branches; panicle slender, 3-7 cm. long, the branches solitary, appressed to the rachis, bearing spikelets to their bases; pedicels from very short to as long as the spikelets, appressed to the branches. Spikelets overlapping, 2.2-2.7 mm. long; first glume 0.6-1.2 mm. long, 1-nerved, lanceolate, acuminate or short-awned; second glume similar, 0.9-1.7 mm. long; lemma narrowly lanceolate, 1.8-2.7 mm. long; nerves prominent, green; internerves white in immature spikelets; callus minutely bearded; awn terminal, 15-25 mm. long, thin, flexuous; palea equal to the lemma; anthers 3, yellow, 0.3-0.4 mm. long. Chromosome number $n = 10$ from Costa Rican specimens.

Moist cliffs and rocky banks, especially in stream valleys, road cuts; Meseta Central to Guanacaste; Valley of Rio Pacuare on the Caribbean slope; elevations from 50 to 1,200 m. October to mid-January. Mexico to Panama.

This delicate little annual grass begins to grow during the rainy season, but remains vegetative for a long time. The onset of blooming is simultaneous over large areas, suggesting that blooming is conditioned by photoperiod. All of the species of this annual group (*M. ciliata*, *M. diversiglumis*, *M. implicata*, *M. tenella*, and *M. tenuissima*) are very similar and may not all merit specific recognition. Some of our specimens of *M. tenella* exhibit large pyriform swellings at some of the lower nodes, each containing an insect grub.

Muhlenbergia tenuissima (Presl) Kunth, Rév. Gram. 1, Suppl. XVI. 1830. *Podosaemum tenuissimum* Presl, Rel. Haenk. 1:230. 1830. *Muhlenbergia nebulosa* Scribn., Beal, Gr. N. Amer. 2:247. 1896.

Delicate, short-lived annual; culms sprawling, 7-30 cm. long, much branched, the internodes slender, hollow, thick-walled, dull, scabrid below the puberulent nodes; leaf sheaths shorter than the internodes, puberulent or glabrous; ligule a thin membrane,

0.8-1.2 mm. long; blades mostly folded, puberulent above, 3-7 cm. long, 0.5-1.0 mm. wide. Peduncle included or exerted up to 3 cm. Inflorescences numerous, terminal on the culm and leafy branches; panicles 4-8 cm. long, open cylindrical, 1-2 cm. wide; branches delicate, filiform, the spikelets long-pedicellate on stiff filiform pedicels which diverge strongly from the branches and are thickened just below the spikelets. Spikelets 1.7-1.9 mm. long; glumes ovate-acuminate, 1-nerved, rarely awn-tipped, the first 0.5-0.7 mm. long, the second similar, 0.8-1.0 mm. long; lemma narrowly lanceolate, 3-nerved, 1.7-1.9 mm. long, ciliate on the margins, the callus not bearded; awn thin, 6-11 mm. long; palea equal to the lemma, ciliate on the keels; anthers 3, purple, 0.5-0.6 mm. long.

Savannas of Guanacaste, near the CIA, Liberia and Las Animas; elevations 100-200 m. December. Southwestern Mexico; Honduras; Costa Rica and Panama.

This delicate little grass resembles *M. implicata*, but differs in the ciliate lemmas, pointed glumes, and smaller spikelets.

NASELLA Desvaux

Perennial grasses; caespitose; culms branching below; inflorescence a terminal panicle. Spikelets 1-flowered, disarticulating above the equal, elongated glumes; lemma ovoid or obovoid, round in cross-section, rigid, the edges overlapping and concealing a short, flattened palea; callus short, oblique, bearded; apex of lemma with a blunt beak at the overlap; awn often eccentrically inserted, geniculate, the basal segment twisted, readily deciduous from the body of the lemma.

This genus is very closely allied to *Stipa* and is sometimes regarded as a section of that genus. It differs in the readily deciduous awn that is often eccentrically attached and in microscopic characters of the antheridium. (Pooideae: Stipeae.)

Nassella linearifolia (Fourn.) Pohl, **comb. nov.** *Stipa linearifolia* Fourn., Mex. Pl. 2:73. 1881. *Oryzopsis florentula* Pilger, Bot. Jahrb. Syst. 27:26. 1899. *Stipa florentula* (Pilger) Parodi, Revista Mus. La Plata, Secc. Bot. 6:228. 1944. Figure 207.

Perennial, in dense clumps; culms erect, freely branching from the lower nodes, the branches mostly short, erect, and very leafy; culms slender, hollow, glabrous; nodes prominent, glabrous, yellowish; sheaths glabrous, firm; ligule a white membrane, 0.5 mm. long; blades stiff, strongly ridged above, involute, 5-17 cm. long, 2-3 mm. wide, glabrous, with a few short auricular hairs. Peduncle 6-12 cm. long, thin, stiff, wiry, glabrous; panicles solitary on the culm or on erect leafy branches, 8-17 cm. long, ovoid, open, the branches paired, naked below, the longest 4-6 cm. long; spikelets appressed along the outer half or third of each branch. Spikelets terete; glumes equal, 4.2-5.0 mm. long, longer than the floret, narrowly ovate, acuminate, rounded on the back, 3-nerved, often purplish, connivent until the floret is shed, then spreading; lemma narrowly obovate-cylindrical, somewhat quadrate; apex obliquely truncate, 2.8-3.0 mm. long, surface brown, minutely roughened, the body appressed-pubescent with white hairs, the short callus white-bearded; margins strongly overlapping and concealing an oblong

membranaceous palea ca. 1 mm. long; awn readily deciduous, 13-15 mm. long, twice geniculate, the lower segment tightly twisted, the second segment less so, both minutely pubescent; floret apparently never opening, the flower cleistogamous; lodicules 3, flat; anther 1, ca. 0.5 mm. long, placed between the stigmas.

Collected once in Costa Rica, from a gully 1 km. below San Juan de Chicao, elevation 2,600 m. Blooming in November. Southern Mexico; Guatemala; Costa Rica; Colombia and Bolivia.

Recent studies of the anatomy of the anthoecia of fossil and living Stipeae by Thomasson indicate that the epidermis of the lemmas of this species is much more similar to that of species of *Nassella* than it is to that of typical species of *Stipa*. This difference is supported by the deciduous nature of the awn and the plump, somewhat flattened floret.

OLYRA Linnaeus

Caespitose perennial grasses, the culms usually elongated, often thick and hardened; leaf blades with short pseudopetioles, often oblique-based; plants monoecious. Inflorescence a panicle, usually bearing pistillate spikelets toward the tips of the branches and staminate ones near the bases. Pistillate spikelets: Glumes equal, several-many-nerved; floret single, disarticulating above the glumes (except in *O. lateralis*); lemma rigid, bony, obtuse, its margins usually inrolled over the edges of a palea of similar texture. Staminate spikelets: Soft-textured; glumes absent; floret 1, disarticulating from the pedicel; lemma 3-nerved, keeled; palea 2-keeled, equal to the lemma; anthers 3.

The plants are somewhat bamboo-like in general aspect, but usually have foliage leaves on the main stem as well as on the branches. They usually bloom annually, in contrast to the woody bamboos, which bloom very irregularly or at long intervals. The leaf anatomy and the possession of pseudopetioles indicate that the genus is bambusoid, although in older systems, it was placed in the tribe Paniceae. In such treatments, the pistillate spikelets were described as missing a first glume and possessing only a second glume and a sterile lemma below the floret. (Bambusoideae: Olyreae.)

KEY TO SPECIES OF *Olyra*

- 1a. Tall, erect, or scrambling plants; leaf blades 12-22 cm. long, 1.5-8.5 cm. wide . . . 2
- 1b. Weak trailing plants; leaf blades 3.5 cm. or less long, 5-10 mm. wide

O. lateralis

- 2a. Sheath auricles spreading, purple, forming horizontal collar around the culm; leaf blades with triangular purple zone at base of nearly symmetrical blade

O. standleyi

- 2b. Sheath auricles erect, inconspicuous, not spreading; leaf blades very oblique-based, not purple-marked at base *O. latifolia*

Olyra lateralis (Presl) Chase, Proc. Biol. Soc. Wash. 21:179. 1908.

Panicum laterale Nees, Agrost. Bras. 213-214. 1829, var. α . *O. sarmentosa* Doell, Mart. Fl. Bras. 2:819. 1877. Figure 124.

Sprawling perennial, the culms up to 4 m. long, branching freely, trailing over banks and low vegetation; internodes 1.0-1.5 mm. thick, hollow, thin-walled, glabrous or puberulent below the nodes; nodes prominent, with 2 circular ridges and a groove between them, retrorsely puberulent; leaf sheaths shorter than the internodes, appressed-puberulent especially toward the apex; ligule a short membrane, 0.2-0.5 mm. long; pseudopetiole puberulent, 0.7-1.0 mm. long; blades flat, rather stiff, narrowly triangular 3-5:1, cordate-based, 1.5-4.0 cm. long, 5-13 mm. wide, sparsely puberulent or scabrid, the margins sometimes ciliate, tapering abruptly to a rather rounded tip; underside glaucous. Inflorescences panicleate, terminal on the culm and also axillary from the upper leaf sheaths, 2-4 cm. long, open-pyramidal, to 3 cm. wide, few-flowered. Pistillate spikelets: Few, at branch tips; dorsally compressed, 2.4-3.0 mm. long, the length 2.0-2.8 $\times$ the width; disarticulation below the equal glumes that completely cover the floret; first glume 5-nerved, stiff, minutely woolly; second glume similar, 3-nerved; floret ovate 3:2, 1.4-1.5 mm. long; lemma rigid; stramineous, striate, with a basal areole; margins thick but not conspicuously inrolled; palea 1.2 mm. long; lodicules 3; style 1; stigmas 3; caryopsis elliptical 3:2, reddish brown, with a persistent style. Staminate spikelets: Borne on lower portions of the branches, 3-4 mm. long, ovate 4.5:1, acute; glumes subequal, 3-4-nerved; anthers 3, purple, 2.0-2.3 mm. long.

This species is rare in Costa Rica, and only one specimen has been collected in the twentieth century. Puntarenas, Ciénaga de Agua Buena, Cañas Gordas, *Pittier 11008*; February 1897, Helechales del General, valleé du Diquís, 700 m., 3 February 1898, *Pittier 12058*; Cordoncillal, *Pittier 3641*; San José, Vicinity of El General, *Skutch 2254*. Peru and Bolivia to Venezuela, Colombia, Panama, and Southern Costa Rica.

Olyra latifolia L., Syst. Nat. ed 10, 2:1261. 1759. Figure 125.

Caespitose perennial, the plants forming clumps of up to 20 culms from a hard, knotty crown; culms up to 6 m. long, erect, arching, scrambling in brush and trees, or decumbent; branching abundant from middle and upper nodes; internodes up to 1 cm. thick, hollow, thick-walled; internodes usually glabrous or, exceptionally, pubescent near the apex, often purplish-spotted; lower sheaths deciduous, those of the branches usually persistent and overlapping, glabrous to hispid and puberulent, the overlapping edge ciliate; apex of sheath prolonged into an auricle; ligule a thick membrane, up to 4 mm. long; pseudopetiole 1-3 mm. long, puberulent to heavily bearded; leaf blades flat, oval 3-7 $\times$ longer than wide, very oblique, one side of the blade narrow and the other wide at the base, these dimensions reversed toward the apex of the blade; apex rather abruptly short-caudate; length 8-22 cm.; width 1.5-8.5 cm.; upper surface usually glabrous, lower surface velvety or glabrous. Inflorescences panicleate, numerous at the apex of the culm and the tips of leafy branches, ovoid or pyramidal, up to 18 cm. long and about a third as wide, open to rather congested. Spikelets unisexual, the pistillate ones usually solitary at the tips of the branches, sometimes several on a branch; pistillate spikelets more abundant toward the apex of the panicle, the staminate ones toward the base of the panicle and on lower parts of the branches. Peduncle, rachis, and branches scabrous to softly hirsute. Staminate spikelets: Borne on appressed pedicels 1-3 $\times$ as long as the

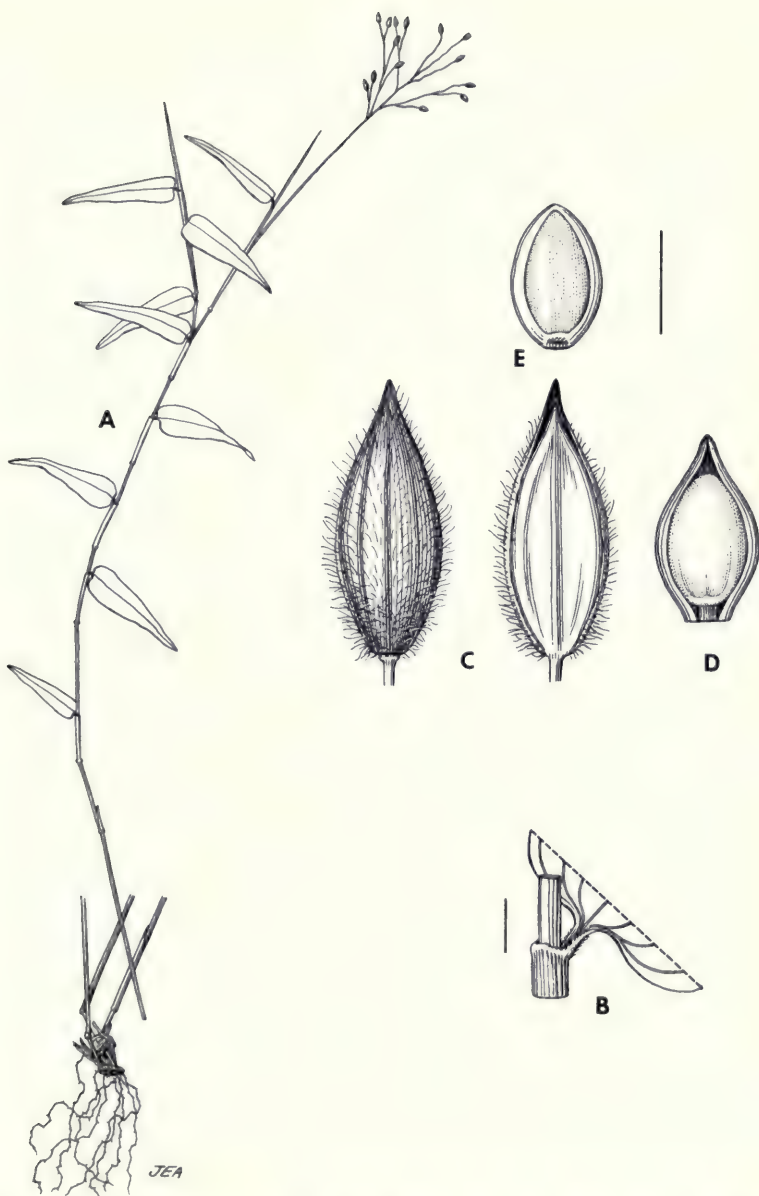


FIG. 124. *Olyra lateralis*. A, blooming plant; B, leaf blade base, showing pseudopetiole; C, two views of a pistillate spikelet; D, pistillate floret within a glume; E, pistillate floret.



FIG. 125. *Olyra latifolia*. Blooming plant, pistillate spikelet, floret, staminate spikelet.

spikelet; membranaceous, ca. 5 mm. long, ovate 6:1, acute; glumes absent; lemma keeled, 3-nerved, bearing a straight awn up to 4 mm. long; palea of equal length, 2-nerved; lodicules 3, truncate, vasculated, bearing 2-3-celled microhairs at the tip; anthers 3, 2.7-3.5 mm. long, brown. Pistillate spikelets: Borne on flattened, thickened pedicels at the tips of branches, or several in a series along a branch, dorsally compressed, 8-15 mm. long, not including the awns; glumes usually glabrous, rarely puberulent; first glume ovate, caudate, tapering gradually into a thick awn up to 20 mm. long; nerves 7-9; second glume similar but with a shorter awn, 5-7-nerved; floret readily deciduous; lemma 4.8-5.2 mm. long, elliptical 1.5-2:1, glabrous, rigid, blunt, white, shiny, rounded on the back, with an evident basal germination lid; margins distinctly inrolled over the edges of a rigid convex palea of similar color and texture, 3.7-4.0 mm. long; lodicules truncate, vasculated; caryopsis filling the cavity of the floret, with a stiff brown pericarp; endosperm opalescent, white, horny. Chromosome number $n = 11, 22$ from Costa Rican and Venezuelan material.

Common in forests and forest margins, at elevations up to 850 m., on both Pacific and Caribbean slopes. New growth is initiated during the rainy season, and the primary panicles bloom then. The development of smaller panicles on the lateral branches, however, prolongs the blooming season throughout the year. Mexico to Brazil, Bolivia, and northern Argentina; West Indies; introduced in Africa. This species is somewhat weedy and thrives in the disturbed margins of forests. It is amazingly variable in stature, leaf size and shape, and pubescence.

***Olyra standleyi* Hitchc., Proc. Biol. Soc. Wash. 40:87. 1927.**

Perennial from hard crowns, the new buds at the base covered with shining overlapping scales; plants 2-3 m. tall, the culms arching, branching from the middle nodes, the branches solitary; prophyllum inserted above the node, to 6 cm. long, ciliate on the keels; internodes to 3 mm. thick, glabrous, thick-walled; nodes conspicuous, with a swollen purplish band overlapped above by the base of the sheath, glabrous or retrorsely puberulent; sheaths glabrous to sparsely retrorsely papillose-hispid; lower sheaths shorter than the internodes, the upper longer and overlapping; sheath auricles present, purple, spreading horizontally and forming a sort of collar around the culm, the margins hispid-ciliate; ligule inconspicuous, a stiff purple membrane ca. 1 mm. long; pseudopetiole ca. 2 mm. long, pubescent; leaf blades flat, glabrous, ovate 4-5:1, nearly symmetrical, 12-24 cm. long, 2.5-5.0 cm. wide, the base cordate, with a conspicuous deltoid purple area at the midrib; surfaces glabrous, the upper dark green, the lower glaucous. Inflorescences terminal on leafy branches; panicle to 15 cm. long and about as wide, open, pyramidal, with successive whorls of stiff ascending branches, the longest 11 cm. long. Staminate spikelets: Numerous, appressed along the lower parts of the panicle branches, short-pedicellate, ca. 1 cm. long; glumes absent; lemma acuminate; palea about equal to the lemma. Pistillate spikelets: 1-10 borne at branch tips, on thickened pedicels; first glume ca. 2 cm. long, including the awn, 5-nerved, glabrous; second glume slightly shorter, 5-nerved; floret 8 mm. long, obtuse, the surface of the lemma minutely pitted, its margins inrolled over the edges of the palea.

The type specimen, which is fruiting, was collected at El Muñeco by Standley and Torres in March 1926 (50932). We have collected vegetative material from what is apparently the same stand, on the road S of

El Muñeco. The plants are conspicuous because of the large size of the leaf blades and are readily identifiable by the purple auricular collar at the apex of the sheath and the purple triangle at the base of the leaf blades. The only other Costa Rican collection is the following: Prov. de Cartago, Moravia de Chirripó, 8 km. camino el Río Chirripó, altitude 1,400 m., January 1976, *R. Ocampo 1212*. This specimen, like recent material from El Muñeco, is vegetative. The distance between these two localities is over 25 km., indicating that the species may probably be found in other intermediate sites. Recent collections from Cerro Jefe, Panama, by Calderón, may be the same species. No other collections are known.

OPLISMENUS Beauvois

REFERENCE: A. S. Hitchcock, The North American species of *Opismenus*, Contr. U.S. Natl. Herb. 22:123-132. 1920.

Creeping grasses, the lower portions of the culms decumbent and rooting; blooming from ascending leafy branches. Duration indefinite, the plants forming large patches by vegetative spread. Inflorescence a slender terminal panicle of short, spikelike racemes; spikelets paired, very short-pedicellate, the pairs borne alternately in 2 rows along the 2 lower sides of the triquetrous rachis of the racemes. Spikelets disarticulating below the glumes, more or less laterally compressed; glumes keeled, subequal, membranaceous, shorter than the spikelet, awned from a bifid tip, the first usually 3-nerved, the second 5-nerved; lower (sterile) lemma 5-9-nerved, awn-tipped or awnless, without a flower or palea, enfolding the fertile floret; upper (fertile) floret shorter than the sterile lemma and concealed by it; lemma dorsally compressed, narrowly ovate, acute, coriaceous, shining, longitudinally finely striate, the margins incurved, flat, overlapping the edges of the equal, slightly convex palea; lodicules 2, truncate; anthers 3; style branches separate, naked at the base.

A small genus of 10-15 species, occurring in the subtropics and tropics of both Old and New Worlds. The plants appear similar to *Pseudechinolaena* in growth habit and to *Echinochloa* in spikelet structure. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Oplismenus*

- 1a. Awns upwardly scabrous; racemes conspicuously whitish, hispid; glumes and sterile lemma longitudinally ridged *O. burmannii*
- 1b. Awns smooth; racemes not hispid; glumes and sterile lemma not ridged 2
- 2a. Racemes very short, appearing wider than long, the rachis 2-6 mm. long; spikelets usually 7 or fewer per raceme *O. setarius*
- 2b. Racemes longer than wide, the rachis of lower racemes 1 cm. or more long, bearing numerous spikelets *O. hirtellus*

Oplismenus burmannii Beauv., Ess. Nouv. Agrost. 54. 1812. Figure 126.



FIG. 126. *Optismenus* species. *O. burmannii*: A, inflorescence; B, spikelet; *O. hirtellus*: C, spikelet.

Duration indefinite, probably annual; plants decumbent, forming large patches, the culms long-decumbent and rooting from the nodes, branching freely, the branches spreading or ascending, 10-30 (50) cm. long, mostly leafy only on the lower half, the naked peduncle comprising more than half of the length; internodes ca. 1 mm. thick, pubescent in a single villous line below the overlapping edge of the sheath above, sometimes also papillose-hispid all over; sheaths shorter than the internodes, densely short-ciliate on the overlapping margin, more or less papillose-hispid as well; ligule a thin ciliate membrane, in total 0.7-1.2 mm. long; leaf blades flat, ovate, 3-4:1, 2-5 cm. long, 9-15 mm. wide, scabrous, puberulent, hirsute, or papillose-hispid. Peduncle 3-18 cm. long, slender, bearded at the apex; inflorescence rather dense, 3-6 cm. long, the 3-7 ascending racemes overlapping; axis and the rachises of the racemes densely papillose-hispid; spikelets paired, subsessile on the lower 2 sides of the triquetrous rachis, often one of the pair reduced or obsolete. Spikelets whitish, conspicuously hispid, 2.8-3.7 mm. long; first glume narrowly ovate, 2.0-2.7 mm. long, 3-nerved, notched at the apex, the purplish antrorsely scabrous awn 5-10 mm. long, attached at the notch; second glume ovate, 5-nerved, the awn 2.5-5 mm. long; lower (sterile) lemma 2.6-3.5 mm. long, elliptical, 7-9-nerved, heavily hispid-bearded in a wide band across the middle, pubescent below the apex on the inner side; palea and flower lacking; upper (fertile) floret 1.9-2.1 mm. long, ovate 3:1, acute, coriaceous, shining, striate; palea equal; lodicules 2, truncate; anthers 3, orange, 1 mm. long; stigmas purple. Chromosome number $n = 18$ from a Costa Rican specimen.

Open dry areas and open shade, roadsides, pastures, stream banks; sea level to 1,900 m. elevation, most common at lower elevations on the Pacific slope, apparently uncommon on the Caribbean slope. October to May. Southern Mexico to northern South America and the Caribbean Islands. Introduced from Asia.

The binomial *O. burmannii* is usually stated to have been based upon *Panicum burmannii* Retz., Obs. Bot. 3:10, 1783. Beauvois, however, makes no reference to the Retz name.

Oplismenus hirtellus (L.) Beauv., Ess. Nouv. Agrost. 54:168. 1812.
Panicum hirtellum L., Syst. Nat. ed. 10. 2:870. 1759. Figure 126.

Duration indefinite; culms 59-90 cm. long, the bases long-decumbent and rooting from the nodes, forming large patches, the rooted portions branching freely; internodes 1 mm. thick, hollow, glabrous or pubescent below the nodes; prophylla broad, up to 1.6 cm. long; nodes glabrous or bearded; sheaths shorter than the internodes, glabrous, pilose, or papillose-hispid, their exposed margins softly ciliate; ligule a ciliate membrane, 0.6-1.2 mm. long; blades flat, thin, lanceolate 4.5-7.5:1, 4-12 cm. long, 7-20 mm. wide, somewhat asymmetric; surfaces glabrous, scabrous, velvety-pubescent, or with a few papillose-hispid bristles at the base. Inflorescences terminal on leafy, ascending or erect branches; peduncles slender, exserted 1.5-12 cm., glabrous or appressed-pilose; inflorescence 7-14 cm. long, composed of 3-7 spikelike 1-sided racemes, arranged racemously along the central rachis; racemes 1-3 cm. long, the rachis glabrous, pilose, or papillose-hispid; spikelets compactly arranged, in pairs, these attached alternately in 2 rows on the 2 lower sides of the triquetrous rachis; 1 spikelet of some pairs reduced or abortive; pedicels very short. Spikelets laterally compressed, 3.0-4.0 mm. long; glumes keeled, the first 1.8-2.5 mm. long, ovate, 3-5-nerved, bearing a smooth, stiff awn 4-10 mm. long, attached just below the summit; second glume 2.0-2.7 mm. long, ovate, 5-7-nerved, with

a short awn 2-4 mm. long, attached just below the summit; lower (sterile) lemma 3.0-3.5 mm. long, ovate, 5-9-nerved, lacking palea or flower; glumes and sterile lemma glabrous, scabrous, or papillose-hirsute; upper (fertile) floret dorsally compressed, 2.5-3.0 mm. long, elliptical 3:2; lemma faintly 5-nerved, shiny, striate, coriaceous, acute, the thin margins covering the margins of the broad palea of equal length; lodicules 2, truncate; anthers 3, yellow-orange, 1.5-1.7 mm. long; caryopsis elliptical 8:3, white.

Usually in shade of brush or open forests, roadsides; sea level to 2,000 m. elevation. Meseta Central, Canton de Dota, Turrialba, Pejivalle, General Valley, Limón area, Tilaran, Hda. Inocentes. May to February, probably yearlong. Mexico to Argentina; Caribbean Islands.

This rather weedy species is amazingly variable in the pubescence of leaves, sheaths, and rachis of the spikes; however, all of our chromosome counts from Costa Rica and Venezuela indicate a single number, $n = 45$.

***Opismenus setarius* (Lam.) Roem. & Schult., Syst. Veg. 2:481. 1817. *Panicum setarium* Lam., Tabl. Encycl. 1:170. 1791.**

Duration indefinite; culms long-decumbent, rooting at the nodes; erect portions 20-30 cm. long; internodes 1 mm. thick, hollow, glabrous or pilose with scattered hairs, especially in a line below the margins of the leaf sheath above; nodes bearded or glabrous; sheaths shorter than the internodes, more or less papillose-pilose or hispid, especially toward the apex; margins ciliate; ligule a thin membrane, ciliate at the apex, ca. 1.5 mm. long; leaf blades 3-5 cm. long, 4-14 mm. wide, appressed-pilose or with scattered papillose-hispid hairs. Inflorescences terminal on leafy erect branches; peduncle slender, exerted 1-11 cm.; panicle 4-9 cm. long, made up of 4-7 short racemes borne singly at the nodes of the rachis; individual racemes very short, the rachis 2-6 mm. long, puberulent, bearing 7 or fewer spikelets, in pairs along the lower sides of the triquetrous rachis; one member of a pair often reduced or abortive. Spikelets more or less laterally compressed, 2.7-3.3 mm. long; first glume 1.7-2.2 mm. long, 3-5-nerved, ovate, rounded or tapered to the tip; awn smooth, 4-5 mm. long, inserted just below the tip; second glume 1.8-2.3 mm. long, 5-nerved, ovate; awn 1.5-2 mm. long; lower (sterile) lemma 2.4-3.0 mm. long, ovate, broad, partially enveloping the fertile floret, 5-7-nerved; awn very short or lacking; palea and flower absent; upper (fertile) floret 2.3-2.7 mm. long, the lemma elliptical, acute, 2.5-3.5:1, cartilaginous, shining, longitudinally striate; palea of equal length, similar; lodicules 2, truncate; anthers 3, 1.3 mm. long, orange.

Rare or overlooked; shaded roadsides and cafetales; Meseta Central, Turrialba, 1,000-1,700 m. August to December. Southeastern United States to Guatemala and Honduras; West Indies; northern South America to Paraguay.

ORTHOCLADA Beauvois

Leaf blades borne on prominent pseudopetioles; blades conspicuously cross-veined; plants bearing numerous hook-shaped microhairs. Inflorescence a large panicle. Spikelets 2-flowered, laterally compressed and keeled, disarticulating below the glumes

and below the second floret; glumes subequal, the first 3-nerved, the second 5-nerved; lemmas 5-7-nerved, acuminate or awn-tipped; rachilla slender, elongate, held by the keels of the palea.

The genus has one species in tropical America and a second in Africa. It belongs to the Centosteceae, a tribe of uncertain relationships, probably close to the bamboos.

Orthoclada laxa (L. Rich.) Beauv., Ess. Nouv. Agrost. 70, 149, 168. 1812. *Aira laxa* L. Rich., Actes Soc. Hist. Nat. Paris 1:106. 1792. Figure 127.

Perennial; caespitose; culms erect or decumbent and rooting at the basal nodes, unbranched, glabrous or slightly puberulent below the nodes; plants mostly 50-120 cm. tall, the panicle making up ca. half the total; leaf sheaths 5-15 cm. long, mostly overlapping, slightly keeled above, densely covered with uncinat microhairs and a few long slender trichomes; sheath auricles prominent, erect; ligule a thickish lacerate-ciliolate membrane less than 1 mm. long; leaf blades borne on pseudopetioles 0.5-4.0 cm. long; blades narrowly ovate, the larger ones 10-20 cm. long, 17-35 mm. wide. Inflorescence a large open, dome-shaped terminal panicle; peduncle included or exerted up to 25 cm., bearing uncinat microhairs; panicle up to 35 cm. long and about as wide, extremely open, the slender branches bearing a few spikelets near their tips; rachis short, usually 4-10 cm. long, abruptly terminating in an acicular bract up to 3 cm. long; major branches up to 25 cm. long, very slender; spikelets borne in small groups near the branch tips and appressed to them. Spikelets 8-10 mm. long, laterally compressed and keeled, disarticulating below the glumes, the second floret also disarticulating; first glume 3.5-4.5 mm. long, lanceolate, 3-nerved; second glume 4-5 mm. long, narrowly ovate, 5-nerved; florets 2, equal, 5-6 mm. long, ovate, acute or awn-tipped, scabrid on upper parts; palea prominent, nearly as long as the lemma, scabrid on the keels near its tip, grasping the slender rachilla by its keels; rachilla 2-3 mm. long, the ultimate segment usually bearing a rudimentary third floret up to 3 mm. long. Chromosome number $n = 12$.

Common in wet forests, forest margins, and cacao groves; elevations below 550 m. near both Atlantic and Pacific coasts, Provinces of Heredia, Limón, and Puntarenas; somewhat weedy; apparently blooming yearlong. Southern Mexico to northern South America.

ORYZA Linnaeus

REFERENCES: D. Chatterjee, A modified key and enumeration of the species of *Oryza* L., Indian J. Agric. Sci. 18:185-192. 1948. T. Tateoka, Taxonomic studies of *Oryza*, I. The *O. latifolia* complex, Bot. Mag. (Tokyo) 75:418-427. 1962.

Aquatic or paludose grasses; inflorescence a terminal panicle. Spikelets 1-flowered, strongly laterally compressed and keeled; glumes reduced to minute ridges or a cupule at the tip of the pedicel; spikelet with 2 reduced sterile lemmas at the base, the fertile floret terminal, all 3 florets disarticulating from the cupule as a unit; lemma 5-nerved, coriaceous, apiculate or awned, the involute margins clasping the marginal ridges of the palea; palea keeled, 3-nerved, similar to the lemma, apiculate; stamens 6.



FIG. 127. *Orthocladia laxa*. Blooming plant.

Several interpretations of the spikelet of *Oryza* have been made. Some authors consider the sterile lemmas as glumes. The fertile floret has also been interpreted as the result of the fusion of two florets, the lower one contributing a lemma and a flower having 3 anthers and a pistil, the upper contributing a lemma and 3 anthers. Species 23, mostly in the tropics of the Old World. The genus is closely related to *Leersia*, differing in the well-developed lower sterile lemmas. (Oryzoideae: Oryzeae.)

KEY TO SPECIES OF *Oryza*

- 1a. Spikelets readily deciduous; ligules 3-6 mm. long; wild plants *O. latifolia*
- 1b. Spikelets persistent on pedicel; ligules at least 10 mm. long; cultivated crop
O. sativa

Oryza latifolia Desv., J. Bot. Desv. II. 1:77. 1813.

Caespitose perennial, rather succulent, in small tufts; culms erect, to 2 m. tall, usually simple, hollow, thin-walled, 5-10 mm. thick, glabrous; nodes glabrous, shrunk; sheaths mostly longer than the internodes and overlapping, glabrous; ligule a stiff membrane, 3-6 mm. long, ciliate at the apex and pubescent on the back; blades of larger plants up to 55 cm. long, 35 mm. wide, usually glabrous, rarely hirsute, scabrous on margins and surfaces; lower leaves with prominent ciliate blade auricles, the upper ones somewhat pseudopetiolate, the pseudopetiole hirsute, the blades tapering to a narrow base. Panicle open, many-flowered, up to 40 cm. long and 20 cm. wide; lower branches verticillate, up to 30 cm. long, with a tuft of short hairs at the bases, the basal portions naked, the secondary branches and spikelets appressed. Spikelets short-pedicellate along the branches, 6-7 mm. long; glumes reduced to 2 minute excrescences at the tip of the pedicel; sterile lemmas awl-shaped, 1-nerved, the first 1-2 mm. long, the second 1.5-2.0 mm.; lemma 5.5-7.0 mm. long, 2.0-2.5 mm. wide, elliptic-oblong, apiculate or with an awn up to 3.5 cm. long, rugose, hispid-ciliate on the margins, nerves, and sometimes the internerves; palea oblong, apiculate, much narrower than the lemma, the pubescence as on the lemma; anthers 6, 2-3 mm. long, yellow. Chromosome number $n = 24$ from Costa Rican material.

Occasional, wet muddy banks, marshes, wet pastures, forest openings; low elevations, 5-300 m.; both Caribbean and Pacific slopes. April to October, probably yearlong. Southern Mexico and the Caribbean Islands to Brazil and Paraguay.

Oryza sativa L., Sp. Pl. 333. 1753. Figure 128.

This is the common cultivated rice, widely cultivated at low elevations in Costa Rica. There are a myriad of cultivated strains, differing mostly in agronomic characteristics. The spikelets may be awned or awnless. As in all cultivated cereals, the spikelets are retained on the plant past maturity, allowing efficient harvesting. Common names: *Arroz*, "rice."



FIG. 128. *Oryza sativa*. Culm base, inflorescence, spikelet.

PANICUM Linnaeus

REFERENCES: S. T. Blake, New criteria for distinguishing genera allied to *Panicum* (Gramineae), Proc. Roy. Soc. Queensland 70:15-19. 1958. Agnes Chase, Notes on genera of Paniceae IV, Proc. Biol. Soc. Wash. 24:103-160. 1911. R. W. Freckmann, Taxonomic studies in *Panicum* subgenus *Dichantherium*, Unpubl. Ph.D. Diss., I.S.U. Library. 175 pp. 1967. F. W. Gould, Nomenclatural changes in the Poaceae, Brittonia 26:59-60. 1974. A. S. Hitchcock & Agnes Chase, The North American species of *Panicum*, Contr. U.S. Natl. Herb. 15:1-396. 1910; and Tropical North American species of *Panicum*, Contr. U.S. Natl. Herb. 17:459-539 + XII. 1915. Chien-Chang Hsu, The classification of *Panicum* (Gramineae) and its allies with special reference to the characters of lodicule, style-base and lemma, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 9:3:43-150. 1965. M. G. LeLong, Studies of reproduction and variation in some *Panicum* subgenus *Dichantherium*, Unpubl. Ph.D. Diss., I.S.U. Library. 228 pp. 1965. L. R. Parodi, Estudios sistemáticos sobre las Gramineae-Paniceae argentinas y uruguayas, Darwiniana 15:65-111. 1969.

Plants annual or perennial, caespitose, rhizomatous, or decumbent and rooting at the base; inflorescence an open or contracted panicle, sometimes with rather simple branches and the spikelets unilaterally disposed along them. Disarticulation below the spikelets. Spikelets more or less flattened on the first glume side and convex on the second glume side, sometimes biconvex or even somewhat laterally compressed; first glume usually much reduced, rarely as much as three-fourths as long as the spikelet, mostly 1-3-nerved, membranaceous; second glume and lower (sterile) lemma subequal, ca. as long as the spikelet, membranaceous, 3-11-nerved; sterile lemma often containing an abortive or well-developed palea, and rarely a staminate flower; upper (fertile) floret stiff or rigid, awnless, the lemma usually smooth and shining, its margins inrolled over the edges of a flat or somewhat convex palea of similar length and texture; lodicules 2, truncate; anthers usually 3; ovary with 2 separate style branches, these naked near the base; stigmas plumose; caryopsis elliptical or obovate, dorsally flattened, with a large embryo.

Panicum is an enormous genus, primarily distributed in warm climates of both eastern and western hemispheres. Early authors used the name in a very inclusive sense, involving most of the species of the subfamily, but a general tendency has been to remove groups of species as segregate genera. Related or segregate genera in our flora include *Brachiaria*, *Digitaria*, *Echinochloa*, *Homolepis*, *Hymenachne*, *Ichnanthus*, *Isachne*, *Lasiacis*, *Leptocoryphium*, *Oplismenus*, *Paspalum*, *Pseudechinolaena*. The genus *Panicum* is generally recognized by the spikelets, which are borne in panicles and are awnless, dorsally compressed, and with a short first glume and subequal second glume and sterile lemma that conceal the rigid floret. A recent pro-

posal has been made by Gould to remove the subgenus *Dichantherium* as a genus; however, these plants lose their distinctiveness in the tropics, and I have continued to include them in *Panicum*. (Panicoidae: Paniceae.)

KEY TO SPECIES OF *Panicum*

- 1a. Spikelets more than 3 mm. long 2
- 1b. Spikelets less than 3 mm. long 11
 - 2a. Fertile lemma rugose *P. maximum*
 - 2b. Fertile lemma smooth 3
- 3a. Spikelets (at least those in axillary inflorescences) pubescent 4
- 3b. Spikelets all glabrous (see also *P. cordovense*) 5
 - 4a. Sheaths, blades, and internodes densely papillose-hispid; spikelets acuminate, all pubescent *P. rudgei*
 - 4b. Sheaths, blades, and internodes sparsely pubescent; spikelets blunt, only those in axillary inflorescences pubescent *P. cordovense*
- 5a. Leaf sheaths and blades densely papillose-pubescent 6
- 5b. Leaf sheaths and blades glabrous or only slightly pubescent on collar and edges 7
 - 6a. Spikelets 3.5 mm. or less long, usually reddish toward base *P. ghiesbreghtii*
 - 6b. Spikelets 4.5-5 mm. long, stramineous or marked with purple . *P. parvum*
- 7a. Spikelets glutinous, often with adhering particles *P. glutinosum*
- 7b. Spikelets not glutinous 8
 - 8a. Plants with slender rhizomes; panicles 10-15 cm. long; lower floret staminate *P. aquaticum*
 - 8b. Plants not rhizomatous (submerged nodes sometimes rooting); panicles large, 35 cm. or more long 9
- 9a. Panicle branches simple, conspicuously whorled; spikelets blunt; sterile lemma inflated by large palea *P. mertensii*
- 9b. Panicle branches rebranched, not conspicuously whorled; spikelets acute or acuminate 10
 - 10a. Leaf blades elliptical, glabrous, 50 cm. or more long, up to 6 cm. wide; first glume more than half as long as spikelet *P. grande*
 - 10b. Leaf blades linear, less than 2 cm. wide; first glume very short; dewlaps deep purple *P. elephantipes*
- 11a. Glumes and sterile lemma pubescent 12
- 11b. Glumes and sterile lemma glabrous 20
 - 12a. Leaf blades ovate, less than 4.5 × longer than wide 13
 - 12b. Leaf blades narrowly ovate to linear, at least 5 × longer than wide 14
- 13a. Panicle very diffuse, spikelets diverging on slender pedicels; spikelets 1.3 mm. or less long, without glands on sterile lemma *P. trichoides*
- 13b. Panicle slender, of up to 15 short, drooping, 1-sided spikelike racemes; spikelets subsessile along their lower sides, at least 1.8 mm. long, usually bearing 2 circular, eyelike glands on sterile lemma *P. pulchellum*
 - 14a. First glume at least half as long as spikelet 15
 - 14b. First glume one-third to one-fourth as long as spikelet 17
- 15a. Fertile lemma rugose, becoming brown when mature *P. sellowii*

- 15b. Fertile lemma smooth, stramineous 16
- 16a. Plants bearing exserted terminal panicles only, the spikelets on spreading pedicels, sparsely hairy; first glume acuminate, ca. half as long as spikelets *P. haenkeanum*
- 16b. Plants bearing exserted primary panicles and small, few-flowered partly included secondary ones, on later leafy branches; spikelets densely pilose; first glume obtuse, ca. three-fourths as long as spikelet *P. pantrichum*
- 17a. Leaf blades and sheaths nearly glabrous, except for prominent cilia along the basal margins of the blades *P. sphaerocarpon*
- 17b. Leaf blades and sheaths pilose or velvety 18
- 18a. Uppermost leaf blades 1-3 cm. long, less than 5 mm. wide; panicles less than 10 cm. long 19
- 18b. Uppermost leaf blades 5-15 cm. long, 10-15 mm. wide *P. viscidellum*
- 19a. Plants branching mostly from the base, forming soft cushions or mounds of foliage; leaf blades and sheaths softly and densely pilose, with hairs up to 5 mm. long
P. laxiflorum
- 19b. Plants branching from culm nodes, with axillary tufts of branches; pubescence mostly of short hairs 1-2 mm. long *P. olivaceum*
- 20a. Fertile lemma pubescent 21
- 20b. Fertile lemma glabrous 23
- 21a. Fertile lemma conspicuously woolly at apex and base; spikelets 1.0-1.3 mm. long; first glume usually absent; panicle dense *P. discrepans*
- 21b. Fertile lemma with scattered appressed hairs; spikelets at least 1.5 mm. long; first glume present 22
- 22a. Panicles 2-6 cm. long, the few branches up to 1.5 cm. long, densely flowered to their bases *P. arundinariae*
- 22b. Panicles 12-17 cm. long, open, branches up to 10 cm. long, the lower half naked, spikelets borne toward tips of branches only. *P. schiffneri*
- 23a. Low, mat-forming plants, less than 10 cm. tall *P. ciliatum*, var. *pubescens*
- 23b. Plants taller, not forming mats or mounds 24
- 24a. Inflorescence a short linear cluster of a few spikelets; plants slender, wiry; leaf blades involute, 1-2 mm. wide *P. stenodes*
- 24b. Inflorescence a many-flowered panicle; plants various, not wiry, usually with flat blades 25
- 25a. Spikelets borne in 1-sided racemes along lower sides of primary or secondary panicle branches, short-pedicellate and crowded 26
- 25b. Spikelets not arranged in 1-sided racemes, randomly disposed in open or crowded panicles 33
- 26a. Leaf blades ovate, less than 6 × longer than wide 27
- 26b. Leaf blades narrowly ovate or linear, more than 10 × longer than wide 29
- 27a. Spikelets 1.0-2.5 mm. long 28
- 27b. Spikelets 2.5-3.0 mm. long, densely crowded, falcate *P. frondescens*
- 28a. Lower floret producing a naked caryopsis *P. irregulare*
- 28b. Lower floret sterile *P. polygonatum*
- 29a. Leaf blades 2.5-3 cm. wide; plants aquatic *P. stagnatile*
- 29b. Leaf blades mostly 1.5 cm. or less wide; mostly plants of wet ground but not truly aquatic 30

- 30a. Leaf blades narrowed to base, not cordate *P. laxum*
 30b. Leaf blades broad or cordate at base 31
- 31a. Panicles rather open, not more than twice longer than wide, the branches up to 11 cm. long, not bearing long hairs *P. boliviense*
 31b. Panicles slender, branches not more than 5 cm. long, often bearing long hairs; nodes often bearded 32
- 32a. Panicles 25-30 cm. long *P. pilosum* var. *lancifolium*
 32b. Panicles usually less than 15 cm. long *P. pilosum* var. *pilosum*
- 33a. Spikelets 2.2 mm. or more long 34
 33b. Spikelets 2.0 mm. or less long 37
- 34a. First glume ca. one-fifth as long as spikelet *P. parviglume*
 34b. First glume half or more as long as spikelet 35
- 35a. Leaf blades elliptic, ca. 10 × longer than wide, up to 6 cm. wide; sheaths glabrous; plants aquatic *P. grande*
 35b. Leaf blades linear, more than 15 × longer than wide, rarely more than 15 mm. wide; sheaths papillose-hispid; plants of open dry areas 36
- 36a. Palea of sterile floret nearly as long as lemma *P. cayennense*
 36b. Palea of sterile floret one-third as long as lemma *P. hirticaulum*
- 37a. First glume half as long as spikelet or shorter 38
 37b. First glume at least two-thirds as long as spikelet 39
- 38a. First glume rudimentary, ca. 0.4 mm. long; ligule a minute membrane
P. trichanthum
 38b. First glume ca. 1 mm. long; ligule a dense row of bristles up to 3.5 mm. long *P. hirsutum*
- 39a. Spikelets 1.7-2.0 mm. long; leaf blades 4-11 mm. wide 40
 39b. Spikelets 1.2-1.6 mm. long; leaf blades 2-3 mm. wide *P. parvifolium*
- 40a. Leaf blades glabrous or with few elongate hairs on cordate base; spikelets 1.7-2.0 mm. long *P. helobium*
 40b. Leaf blades pubescent on both surfaces; spikelets ca. 2 mm. long
P. errabundum

***Panicum aquaticum* Poir., Lam. Encycl. Suppl. 4:281. 1816. Figure 129.**

Perennial; bases rhizomatous, the rhizomes often vertical; culms erect to decumbent, 45-130 cm. long; internodes 1.5-4.0 mm. thick, hollow, glabrous; nodes glabrous; leaf sheaths ca. as long as the internodes, glabrous; collar and throat sometimes sparsely pilose; ligule a short, long-ciliate membrane, in total 0.6-1.7 mm. long; leaf blades 7-27 cm. long, 5-7 mm. wide, linear, rather abruptly pointed, usually glabrous, rarely papillose-pilose near the base above. Peduncles included or exerted up to 5 cm.; panicles terminal, broadly ovoid, 10-18 cm. long, 7-11 cm. wide, the longest branch 6-11 cm. long; branches ascending, naked near the base, the spikelets usually appressed along the scabrous branches. Spikelets ovate, acuminate, (3.0) 3.3-3.7 mm. long, glabrous; first glume 1.1-1.5 mm. long, acute, wider than long; second glume 3.3-3.6 mm. long, 9-11-nerved; lower (sterile) lemma 3.0-3.5 mm. long, 9-11-nerved, enclosing a well-developed, keeled palea and sometimes a staminate flower with 3 orange anthers 1.1-1.3 mm. long; palea usually as long as or longer than the lemma; upper (fertile) floret 2.3-3.0 mm. long, ovate 2.0-2.5:1, the lemma smooth, shining, rigid, minutely cuspidate; palea similar, flat;

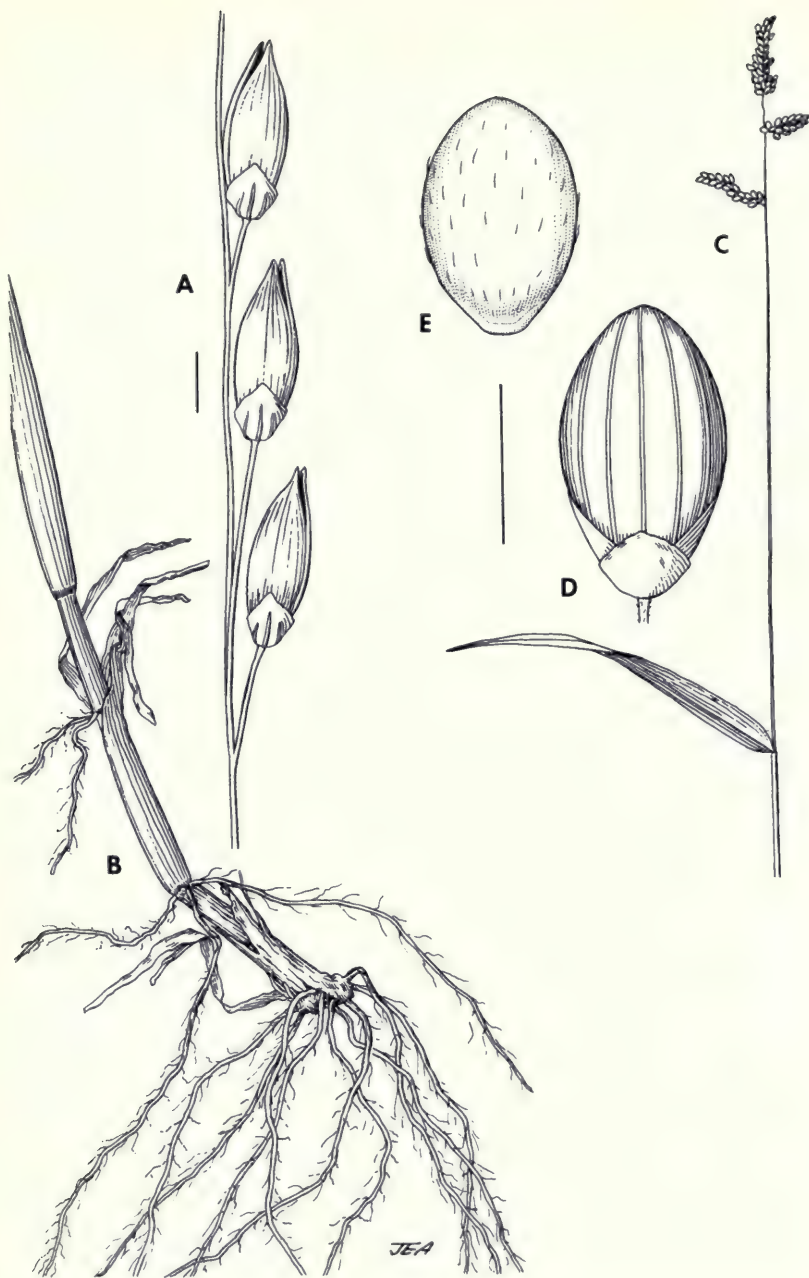


FIG. 129. *Panicum* species. *P. aquaticum*: A, branch of inflorescence; B, base of culm; *P. arundinariae*: C, panicle; D, spikelet; E, fertile floret.

anthers 1.6 mm. long; caryopsis ca. 1.7 mm. long, elliptical 2:1. Chromosome number $n = 36$ from a Costa Rican specimen.

Wet pastures, ditches, sandbars in rivers; scattered in a few localities on the Pacific slope; elevations from 50-1,700 m. Known from Viente Siete; along the road to Hda. Inocentes; Capellades. Apparently blooming yearlong. Mexico to Costa Rica, southward to Paraguay. West Indies.

Past descriptions do not mention the presence of rhizomes, but all of our specimens have them. One specimen from the marsh along the railroad at the Radiografica Transmitter is very tall, up to 2 m. high and has hispid foliage. It is otherwise similar to the other specimens and has the same chromosome number.

***Panicum arundinariae* Trin. ex Fourn., Mex. Pl. 2:25. 1881. *P. virgultorum* Hack., Oesterr. Bot. Z. 51:369. 1901. Figure 129.**

Caespitose perennial; culm bases often decumbent and rooting; culms mostly 50-80 cm. long, scrambling in brush or hanging over embankments, branching freely; internodes 1.0-1.5 mm. thick, hollow, thick-walled, glabrous; nodes bearded; prophylla hirsute, 10-12 mm. long; sheaths overlapping or shorter than the internodes, minutely ciliate on the margin, the surface glabrous except for the bearded auricles and collar; ligule a minutely ciliate membrane, 0.3-0.8 mm. long; leaf blades flat, 4-11 cm. long, 4-9 mm. wide, ovate 10-13:1, the base rounded; surfaces nearly glabrous or sparsely appressed-pilose, especially toward the tip. Peduncles slender, exserted 4-17 cm.; panicles terminal on leafy branches, 2-6 cm. long, small and rather simple, made up of 3-5 short branches 0.5-1.5 cm. long which are densely flowered to their bases. Spikelets elliptical-obovate, 1.7-1.9 mm. long, glabrous, dorsally compressed but slightly biconvex, blunt; first glume a nerveless translucent scale, 0.5-0.6 mm. long; second glume and lower (sterile) lemma very similar, equal, 5-nerved; upper (fertile) floret 1.5-1.6 mm. long, blunt, broadly elliptical, less than twice as long as wide; lemma finely striate, stramineous, shining, with scattered fine pilose hairs; palea similar, slightly convex; lodicules 2, truncate; anthers 3, orange, 0.7 mm. long; styles 2, separate; caryopsis elliptical 1.5:1, 1.1 mm. long, yellowish, with a red dot over the embryo. Chromosome number $n = 18$ from Costa Rican specimens.

Scattered in the Meseta Central, San Ramón area, and the Cartago Valley, at elevations of 1,000-1,800 m. In shrubbery, often on brushy roadbanks. June to February. Southern Mexico to Panama.

***Panicum boliviense* Hack., Fedde Repert. Sp. Nov. 11:19. 1912.**

Duration indefinite, probably perennial; culms 60-125 cm. long, the bases often long-decumbent and rooting at the nodes, branching from the rooted nodes and middle nodes of erect portions; prophylla ca. 5 cm. long; culm internodes 1.5-2.0 mm. thick, hollow, glabrous; nodes glabrous or slightly bearded; leaf sheaths shorter than or equal to the internodes; overlapping margin pilose-ciliate; collar pilose; surface glabrous or papillose-pilose toward the apex; ligule a minutely ciliate membrane, 0.2-0.5 mm. long; leaf blades glabrous, or pilose just above the ligule, more or less cordate at the base, with a very short pseudopetiole; length usually 15-17 (32) cm., width 11-15 mm., the

length 11-14 × the width. Inflorescence terminal on leafy branches; peduncle included in the uppermost sheath or exerted up to 10 cm.; panicles open, elliptical, 18-32 cm. long, 3-5 × as long as wide, the longest branch 6-14 cm. long; spikelets densely clustered and short-pedicellate on the lower sides of the triquetrous primary or secondary branches. Spikelets 1.3-1.8 mm. long, ovate, rather blunt, biconvex in lateral view, distended by the enlarged palea of the sterile lemma and often gaping; first glume 0.7-1.0 mm. long, broadly ovate, usually 3-nerved, acute; second glume 1.3-1.7 mm. long, 5-nerved, convex; lower (sterile) lemma 3-nerved, 1.2-1.6 mm. long, enclosing an enlarged palea nearly as long; upper (fertile) floret elliptical or ovate, 1.1-1.6 mm. long, acute, stramineous; palea similar, flat; lodicules 2, truncate; anthers usually 2, purple, 0.5-0.6 mm. long. Chromosome number $n = 20$ from a number of Costa Rican specimens.

Wet forested areas, mostly near the Pacific Coast, around the Bay of Nicoya; Cariblanco; Osa Peninsula; Buenos Aires; elevations mostly sea level to 400 m. June to August. Southern Mexico to Panama, south to Argentina; Cuba.

Panicum boliviense is very similar to *P. laxum* in spikelet structure and size and shares the same chromosome number. It differs from *P. laxum* primarily in size and vigor, in the wider and more cordate-based leaf blades, and the larger and more branched inflorescence. The two appear to be very closely related, with *P. boliviense* perhaps representing a large extreme of *P. laxum*.

***Panicum cayennense* Lam., Tabl. Encycl. 1:173. 1791.**

Caespitose annual; culms erect or spreading, 18-40 cm. tall, in small clumps, branching from the base and middle nodes; internodes 1-2 mm. thick, hollow, papillose-hispid to nearly glabrous; leaf sheaths mostly overlapping, papillose-hispid; ligule a short membrane, ca. 0.3 mm. long, bearing a row of stiff hairs, in total 0.8-1.2 mm. long; leaf blades linear, 9-18 cm. long, 5-8 mm. wide, more or less papillose-pilose on the surface. Peduncles mostly included in the upper sheaths; panicles several, terminal and from the upper leaf axils, commonly becoming tangled into an elongated compound inflorescence; individual panicles 5-16 cm. long, 4-8 cm. wide, ovoid; branches divaricate; pulvini pubescent, branches scabrous; pedicels divaricate, the terminal ones elongated, stiff. Spikelets obovate 1.6-1.75:1, short-cuspidate, biconvex, 2.1-2.3 mm. long; first glume 1.3-1.6 mm. long, broadly ovate, 5-nerved; a stout rachilla internode ca. 0.4 mm. long between the first and second glumes; second glume 1.8-2.0 mm. long, 7-nerved; lower (sterile) lemma 1.8-2.0 mm. long, 5-nerved, enclosing a well-developed palea ca. 1.5 mm. long, sometimes with abortive anthers; upper (fertile) lemma 1.4-1.5 mm. long, broadly elliptical 1.4-1.5:1, rigid, shining, stramineous; palea similar, convex; lodicules 2, truncate; anthers 3, deep purple, 0.7-0.9 mm. long; styles 2, separate; stigmas purple.

This species has been collected repeatedly on the savannas around Buenos Aires; Boruca, Hda. Argentina; elevations 380-450 m. February to July. Southern Mexico to northern South America; Cuba.

Panicum ciliatum* Ell., Bot. S.C. & Ga. 1:126. 1816, var. *pubescens* (Vasey) Freckmann, comb. nov. *P. laxiflorum* Lam., var. *pubescens

Vasey, Contr. U.S. Natl. Herb. 3:30. 1892. *P. strigosum* Muhl. in Ell., Bot. S.C. & Ga. 1:126. 1816.

Caespitose perennial, forming dense rosettes or circular mats; plants 6-15 cm. tall; culms branching from the base or lowermost node; internodes slender, less than 0.5 mm. thick, hollow, thin-walled, glabrous; nodes appressed-pilose; foliage leaves 2-3 per culm; leaf sheaths overlapping, mostly glabrous except for the finely pilose overlapping margin; ligule a minute ciliolate membrane, 0.1-0.2 mm. long; leaf blades flat, ovate 6-7.5:1, rounded to the base, glabrous or sparsely pilose on the surface, strongly pectinate-ciliate on the margins nearly to the tip with hairs up to 3 mm. long. Inflorescence terminal; peduncle exserted 2-5 cm.; panicles pyramidal, 2-4 cm. long, 1-3 cm. wide, the rachis and branches conspicuously soft-pilose, the hairs up to 2 mm. long; pedicels elongate, spreading. Spikelets 1.3-1.5 mm. long, obovate 1.7:1, glabrous, obtuse; first glume broadly ovate, ca. as wide as long, acute, 1-nerved, 0.6-0.7 mm. long; second glume and lower (sterile) lemma subequal, 1.2-1.3 mm. long, 5-nerved; sterile lemma with a hyaline palea 0.3-0.5 mm. long; upper (fertile) floret ca. 1.0 mm. long, elliptical, the lemma smooth and shining, rigid; palea similar, flat; anthers 3, purple, ca. 0.3 mm. long.

There are no recent collections of this species from Costa Rica. A single old collection by Otón Jimenez is in US. The locality is indicated as "de Candelaria a San Cristobal." Since this is primarily a species of low coastal savannas, the locality is somewhat suspect. Southern Mexico, Belize, Guatemala, Nicaragua; Colombia; West Indies; south-eastern United States.

This taxon belongs to the informal group *Laxiflora* of Hitchcock and Chase, included in the subgenus *Dichanthelium*. Its closest relative in our flora is *P. laxiflorum*.

***Panicum cordovense* Fourn., Mex. Pl. 2:26. 1881. Figure 130.**

Duration indefinite, probably perennial; plants creeping or scrambling in brush; bases of culms long-decumbent and rooting; total length up to 2 m., the ascending portions 40-120 cm. long, branching freely, the branches divaricate; internodes 1-2 mm. thick, hollow, glabrous; nodes glabrous or hispid, dark; leaf sheaths shorter than the internodes, glabrous, papillose, or papillose-hispid; margins finely ciliate; ligule an erose membrane, 0.2-0.4 mm. long; leaf blades 5.5-12 cm. long, 8-12 mm. wide, flat, narrowly ovate 7-11:1, slightly oblique at the subcordate base; surfaces glabrous or sparsely papillose-hispid; pseudopetioles very short, less than 1 mm. long. Terminal inflorescences large and open, 13-30 cm. long, 13-26 cm. wide, pyramidal, few-flowered; branches solitary or paired; pulvini bearded. Spikelets of terminal panicles solitary or paired, on unequal pedicels, appressed along the primary or secondary panicle branches, glabrous, ovate 2.4-2.6:1, blunt-tipped, strongly nerved, 3.1-3.6 mm. long; first glume 2.2-2.6 mm. long, ovate 1.8:1, blunt-tipped, 3-nerved; second glume 2.9-3.2 mm. long, 5-7-nerved, slightly shorter than the spikelet; lower (sterile) lemma 2.8-3.2 mm. long, 7-nerved, lacking palea and flower; upper (fertile) floret 2.4-3.1 mm. long, obovate 2.2-2.3:1, the lemma stramineous, smooth, shining, rigid, apiculate; palea similar, flat; lodicules 2, truncate; anthers 3, 1.1-1.7 mm. long, orange; styles 2, separate; stigmas purple. The spikelets of the terminal panicles seem to set seed rarely, and the one caryopsis seen was small (1.2 mm. long). Axillary panicles small, few-flowered, the spikelets crowded, some hidden in the sheaths; spikelets of the axillary panicles finely

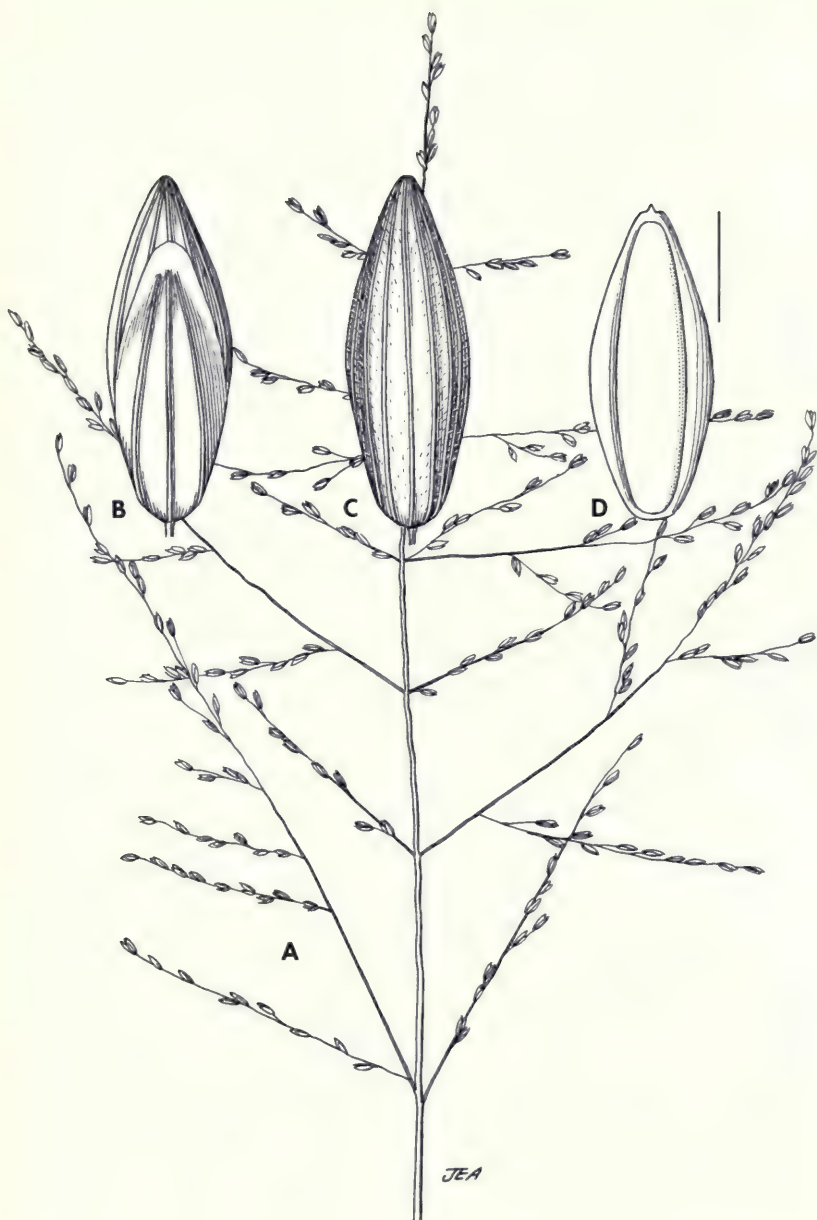


FIG. 130. *Panicum cordovense*. A, panicle; B, spikelet from a terminal panicle; C, spikelet from an axillary panicle; D, fertile floret.

pilose, 3.5-3.8 mm. long, slightly wider than those of the terminal panicles, ovate 1.9-2.1:1; fertile floret obovate, 2.8-3.0 mm. long; anthers small, 0.3-0.4 mm. long, remaining trapped within the floret; caryopsis broadly elliptical 1.5:1, tan. Chromosome number $n = 27$ from a Costa Rican specimen.

Moist forested areas, brushy roadsides, trails; mostly on the volcanoes of the Cordillera Central; San Ramón area; moist lower canyons of the Talamanca Range; Finca Las Cruces, San Vito. Blooming mostly from June to October. Southern Mexico to Brazil and Bolivia.

This species is peculiar in having both glabrous chasmogamous spikelets in the terminal inflorescences and pubescent cleistogamous ones in the later axillary inflorescences. *Panicum pantrichum* is similar. Although this dimorphism is somewhat similar to that which occurs in the subgenus *Dichantherium*, the similarity is probably due to convergence, since the two groups are entirely different in vegetative habit and chromosome number.

Panicum discrepans Doell in Mart., Fl. Bras. 2:2:252. 1877. Figure 131.

Perennial; culms 25-40 cm. long, decumbent, unbranched; internodes 1.0-1.5 mm. thick, solid, glabrous; nodes dark, contracted, glabrous; foliage at the base of the culms densely and conspicuously pilose; leaf sheaths shorter than the internodes, all except the lowermost glabrous except for the ciliate margins; ligule a dense row of stiff white hairs, 2.0-2.5 mm. long, conspicuous; leaf blades 1.5-3.5 mm. long, 2-3 mm. wide, glabrous, more or less inrolled. Peduncle exserted up to 4 cm.; panicles terminal on the culms, in our specimen 2-3 cm. long, contracted, the branches ascending, to 1.5 cm. long; spikelets dark, densely crowded along the branches, short-pedicellate. Spikelets 1.1-1.2 mm. long, ovate 2.5:1, glabrous externally, plano-convex; first glume absent in ours, said by Hitchcock to be up to half as long as the spikelet in some; second glume and lower (sterile) lemma equal, as long as the spikelet, nerves 3, nearly parallel, purple; the internerves purple-dotted; upper (fertile) floret ca. 1.0 mm. long, ovate 2:1, the lemma strongly convex, densely woolly at base and apex; palea equal, flat; lodicules 2, truncate; anthers 3, purple, 0.3-0.4 mm. long.

The only known Central American specimen of *P. discrepans* is the following: Prov. Puntarenas: Muy común en los bordes de una charca estacional. Tallos postrados. Mezclado con *Cyperus haspan*. Cerca del cruce a Buenos Aires de Osa. Bermudez & Sanchez 329, 23 May 1976. Brazil, Cuba.

Panicum elephantipes Nees, Agrost. Bras. 165. 1829.

Duration indefinite, probably perennial; culms up to 160 cm. long, the basal portions of the stems submerged and rooting profusely from the nodes; branching not seen; internodes ca. 1 cm. thick, hollow, thin-walled, glabrous; nodes contracted, purple, glabrous; leaf sheaths mostly overlapping, glabrous, with hyaline margins; auricles ciliate; dewlap conspicuous, deep purple; ligule a dense row of white hairs, 2-3 mm. long; leaf blades 30-54 cm. long, 11-20 mm. wide, with a broad, subcordate base, glabrous or with a few

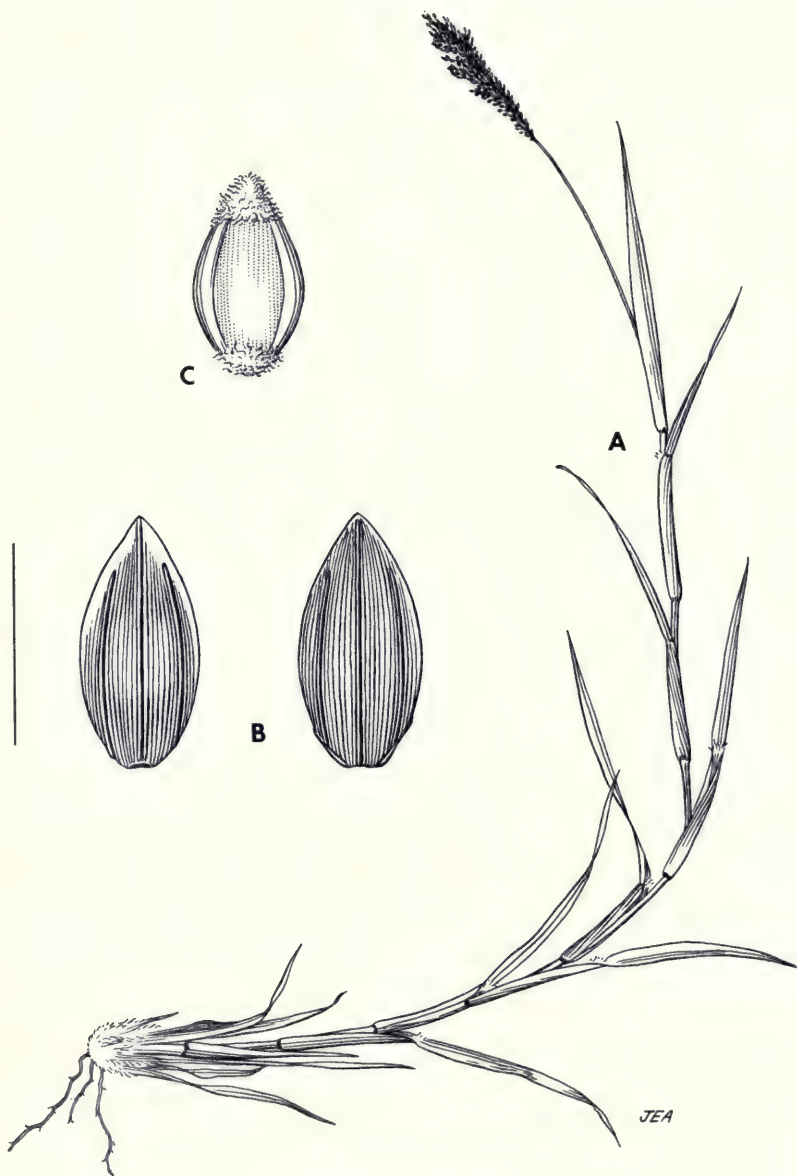


FIG. 131. *Panicum discrepans*. A, blooming plant; B, two views of a spikelet; C, fertile floret, pubescent at base and tip.

hairs on the upper surface behind the ligule. Peduncle included in the uppermost sheath; panicles terminal, solitary, up to 30 cm. long and half as wide, ovoid, rather dense, the numerous branches ascending, scabrous; spikelets mostly paired and unequally pedicellate, appressed along the branches. Spikelets ovate 4:1, acuminate, 3.8-4.2 mm. long, glabrous; first glume triangular 2:1, hyaline, faintly nerved, 1.0-1.2 mm. long; second glume and lower (sterile) lemma equal, as long as the spikelet, 5-7-nerved; upper (fertile) floret ca. 3.5 mm. long, ovate 4:1, acuminate; lemma firm but not indurate, shining, the edges thin and scarcely inrolled; palea similar, flat; lodicules 2, bifid; anthers 3, orange, 1.6-1.8 mm. long; styles 2, separate, naked below, the stigmas purple or brown, exerted; caryopsis not seen.

The following is the only collection from Costa Rica: Prov. Limón, sandbar, Barro de Colorado, elevation 1 m., 14 December 1974, *Pohl & Lucas 13026*. El Salvador, Honduras, Guatemala, Belize; West Indies; tropical South America to Argentina.

Panicum errabundum Hitchc., Contr. U.S. Natl. Herb. 22:494. 1922.

Duration indefinite, probably perennial; culms long-decumbent and rooting and branching at the prostrate nodes, the total length up to 140 cm.; internodes glabrous, purple-spotted, 1.0-1.5 mm. thick, hollow; nodes purple, not prominent; sheaths shorter than the internodes, spreading-pilose; ligule a minute membrane, ca. 0.2 mm. long; leaf blades flat, the base cordate, 4-8 cm. long, 4-8 mm. wide, softly pilose above and below. Inflorescences terminal on erect portions of culms; panicles very open, broadly pyramidal, up to 10 cm. long and 12 cm. wide; peduncle, branches, and pedicels glabrous, purplish; branches solitary or paired, strongly divergent; pedicels divergent, 1-3 times as long as the spikelets, flexuous. Spikelets ovate 2:1, strongly convex or biconvex, purple, glabrous, 1.9-2.1 mm. long; first glume broadly ovate, acute, 3-nerved, ca. 1.5 mm. long; second glume as long as the spikelet, 5-nerved; lower (sterile) lemma 4-nerved, bulging, inflated by the enlarged palea that is ca. as long as the lemma, chartaceous, with inflexed margins; upper (fertile) lemma stramineous, shining, faintly striate, ca. 1.7 mm. long, elliptical 2:1; anthers 3, purple, ca. 1 mm. long; style branches 2, separate.

The following Costa Rican specimen is the only recorded North American collection: Prov. Puntarenas, Cañas Gordas, elevation 1,160 m., dense undergrowth in a marsh, old crater, 26 September 1968, *P. & D. 11159*. This species was described by Hitchcock from Parika, British Guyana. This species belongs to the group *Parvifolia*. See further discussion under *P. helobium*. The specific epithet, unexplained by Hitchcock, means "wandering" and refers apparently to the decumbent habit of the plants.

Panicum frondescens Mey., Prim. Fl. Esseq. 56. 1818. Figure 132.

Duration indefinite, probably perennial; culms long-decumbent and rooting at the decumbent nodes; erect branches from the rooted nodes 10-60 cm. long, sparsely branched from the lower and middle nodes; internodes 1-2 mm. thick, hollow, glabrous or with a woolly line down one side; nodes dark, not prominent, mostly glabrous; leaf



FIG. 132. *Panicum frondescens*. A, panicle; B, panicle branch with spikelets; C, stoloniferous base of plant; D, spikelet; E, fertile floret.

sheaths shorter than the internodes, pilose-ciliate on the overlapping margin; apex ciliate, auriculate; collar with a pilose-ciliate external ligule; internal ligule a short membrane, ca. 0.2 mm. long, continuous with the margin of the auricles; leaf blades flat, ovate 4-6:1, 2.5-9.5 cm. long, 7-17 mm. wide, rounded at the base to a short pseudopetiole ca. 1 mm. long; surfaces glabrous to sparsely appressed papillose-pilose. Peduncle puberulent or pilose; rachis puberulent, especially around the nodes; panicles terminal on leafy branches, dense, spirelike, the length 4-6 × the diameter, composed of numerous ascending or drooping 1-sided racemes, the lowermost ones remote, the uppermost densely crowded. Spikelets densely crowded along the lower sides of the branches, short-pedicellate in pairs that alternate along the lower 2 sides of the triquetrous rachis. Spikelets 2.5-2.7 (3.1) mm. long, falcate, biconvex, somewhat laterally compressed; first glume broadly ovate, acute, 1.0-1.1 mm. long, 3-nerved; second glume 2.3 (2.8) mm. long, 5-nerved, strongly convex; lower (sterile) lemma 2.5 (2.8) mm. long, slightly longer than the second glume, 5-nerved, strongly convex, saccate just above the base; palea membranaceous, 1.4-1.5 mm. long; upper (fertile) floret 1.3-1.5 mm. long, the lemma smooth, shining, rigid, ovate, acute, dorsally compressed; palea similar, flat; anthers 3, 0.5-0.6 mm. long; styles 2, separate; caryopsis ca. 0.8 mm. long, elliptical, amber.

This species is found occasionally in rain forests, cacao groves, or shallow standing water at elevations below 100 m. Limón, Zent, La Bomba, Cahuita, Siquirres, Guapiles, Dos Bocas, Rincón de Osa, Puerto Cortes, Palmar. Southern Mexico to Honduras and Costa Rica; Caribbean Islands; South America to northern Argentina.

The spikelets of *P. frondescens* resemble those of species of *Sacciolepis* in being biconvex and possessing a palea in the sterile lemma; however, there is no similarity in the general structure of the plants. The closest relatives of this species appear to be the members of the *Panicum laxum* alliance, which resemble it in general plant structure and the possession of an enlarged palea in the sterile lemma.

***Panicum ghiesbreghtii* Fourn., Mex. Pl. 2:29. 1881.**

Duration indefinite, probably annual; plants caespitose; culms 35-110 cm. long, decumbent to ascending, branching from the base and middle nodes; internodes 1.0-2.5 mm. thick, hollow, papillose-pilose; nodes bearded; leaf sheaths mostly shorter than the internodes, papillose-pilose; ligule a short membrane, 0.3-0.5 mm. long, bearing a dense row of straight white cilia, in total 1-2 mm. long; leaf blades linear 27-40:1, 11-30 cm. long, 4-8 mm. wide, flat, papillose-pilose; midrib conspicuous, white. Peduncles sparsely papillose-pilose; panicles terminal and axillary, open, ovoid-pyramidal 2-3:1; spikelets on divergent pedicels. Spikelets biconvex, 3.2-3.7 mm. long, ovate, acuminate 2.3:1; first glume broadly ovate, 1.8-2.3 mm. long, 5-nerved; second glume and lower (sterile) lemma separated from the first glume by a thick rachilla internode ca. 0.5 mm. long; second glume 2.6-3.1 mm. long, 7-nerved; lower lemma 2.8-3.5 mm. long, 9-nerved; upper (fertile) lemma ovate ca. 2:1, 2.2-2.4 mm. long, shining, rigid, stramineous; palea similar, flat; anthers 3, purple, ca. 1.0 mm. long.

Coastal low savannas, from Hacienda la Taboga to the Nicaraguan border, at elevations below 200 m.; western portions of the Meseta

Central, where probably introduced. June to February. Southern Mexico to Panama and Colombia; West Indies.

This species is closely related to *P. hirticaulum*, *P. parcum*, and *P. cayennense*. Although Hitchcock and Chase assumed that it is a perennial, it is impossible to be certain of this from herbarium specimens.

***Panicum glutinosum* Swartz, Prodr. Veg. Ind. Occ. 24. 1788.**

Caespitose perennial; culms 55-160 cm. long, unbranched, the bases sometimes decumbent and rooting; plants sprawling in brush; internodes 2-4 mm. thick, hollow, glabrous; nodes glabrous; leaf sheaths longer or shorter than the internodes, glabrous; sheath auricles and dewlaps pilose; ligule a minute membranaceous rim, 0.1-0.2 mm. long; leaf blades 11-44 cm. long, 8-28 mm. wide, mostly glabrous except for prominent papillose-based cilia on the lower margins, rarely sparsely papillose-hispid above. Inflorescences solitary, terminal; peduncle exserted up to 17 cm.; panicle open, broadly ovoid, 12-35 cm. long, 7-17 cm. wide, the longest branch up to 17 cm. long; lower branches verticillate; pulvini pilose; spikelets borne on elongate spreading pedicels, mostly toward the outer half of the branches; pedicels 2-many $\times$ as long as their spikelets. Spikelets 3.0-3.5 mm. long, plump, obovate 2:1, glabrous, the bracts usually glutinous and becoming covered with attached particles, rarely trapping insects; first glume nearly as long as the spikelet, 2.8-3.1 mm. long, 5-nerved, ovate, covering most of the sterile lemma; second glume 2.5-3.0 mm. long, very broad, the margins enwrapping the edges of the sterile lemma; nerves 7; lower (sterile) floret 2.6-3.2 mm. long, 5-nerved; sometimes enclosing a narrow, tongue-shaped nerveless palea 2.0-2.4 mm. long; upper (fertile) floret 2.8-3.1 mm. long, obovate, acute; lemma smooth, shining, rigid, stramineous; palea equal; anthers 3, purple, 1.0-1.5 mm. long; flowers apparently mostly cleistogamous, the anthers remaining trapped within the lemma, along with a developing caryopsis. Chromosome number $n = 20$ from Costa Rican and Venezuelan specimens.

Brushy areas at intermediate altitudes from 700-1,800 m. elevation; central and southern Costa Rica; San Ramón area; Tejar, Agua Caliente, Bajo Pacuare, San Cristobal Norte, Helechales del General, Cañas Gordas. Apparently blooming yearlong. Mexico to Bolivia and Paraguay; West Indies.

The unique feature of this species is the viscid character of the outer bracts of the spikelets, which causes them to adhere to passing animals. The species has no obviously close relatives in our flora.

***Panicum grande* Hitchcock & Chase, Contr. U.S. Natl. Herb. 17:529. 1915. Figure 133.**

Duration perennial; plants coarse, 2-4 m. tall, erect from decumbent or stoloniferous bases; culms mostly unbranched; lower nodes often producing masses of roots where submerged in water; internodes 1-1.5 cm. thick, hollow, glabrous; nodes appressed-silky; sheaths mostly longer than the internodes, glabrous, the margins hyaline; ligule a thick, minutely ciliate membrane, 1.0-2.5 mm. long; dewlap sometimes slightly pubescent, dark colored; leaf blades large, flat, usually 35-75 cm. long, 3-5 cm. wide, elliptical 19-15:1, tapering to the narrow base, the apex not acuminate; surfaces glabrous; margins strongly scabrous. Inflorescences terminal on leafy culms; peduncle glabrous, exserted;



FIG. 133. *Panicum grande*. A, panicle; B, leaf blade; C, two views of a spikelet.

panicle large, open-pyramidal, 55-70 cm. long, 25-40 cm. wide, the branches whorled, spreading or ascending, the secondary and tertiary branches and spikelets more or less appressed along the primary branches; pedicels appressed, mostly shorter than the spikelets. Spikelets ovate 3.1-3.4:1, glabrous, 2.5-2.9 mm. long, rarely longer in terminal spikelets; first glume ovate, acute, 3-nerved, 1.6-2.0 mm. long, ca. two-thirds as long as the spikelet; second glume and lower (sterile) lemma subequal, exceeding the fertile floret, 2.0-2.5 mm. long, 5-nerved; upper (fertile) floret 1.5-1.8 mm. long; lemma elliptical, 2.0-2.4:1, stramineous, shining; palea similar; lodicules 2, truncate; anthers 3, purple, 0.7-1.1 mm. long; styles 2, separate; caryopsis 0.9-1.1 mm. long, oblong-elliptical, plump, gray, the lower portion suffused with purple. Chromosome number $n = 10$ from Costa Rican specimens.

Forming large colonies mostly in coastal marshes, usually in standing water or on mud; Lago de Arenal, Matapalo, Tarcoles, Golfito, Pigres, along the canal between Parismina and Moín; San Isidro, Chitaria, Guapiles. September to December. Guatemala to Panama; northern South America to Brazil.

This is one of the largest and most conspicuous of the herbaceous grasses.

Panicum haenkeanum Presl, Rel. Haenk. 1:304. 1830. *P. costaricense* Hack., Oesterr. Bot. Z. 51:428. 1901.

Duration indefinite; plants sprawling or trailing, scrambling into brush, rooting from the lower nodes; culms to 2 m. long, branching from the base and middle nodes; internodes elongated, ca. 1 mm. thick, hollow, sparsely pilose; nodes not prominent, glabrous; leaf sheaths much shorter than the internodes, sparsely pilose; collar densely bearded; ligule a short membrane, 0.3-0.5 mm. long; leaf blades flat, ovate ca. 10:1. Peduncles short-exserted; panicles terminal on leafy culms, ovoid, rather delicate, 7-16 cm. long; spikelets widely spreading on delicate, flexuous, elongated pedicels. Spikelets elliptical 2.5-3.0:1, acute, 2.4-2.6 mm. long; first glume broadly ovate, acuminate, 3-nerved, the lower margins overlapping; second glume and lower (sterile) lemma subequal, 5-nerved, 2.2-2.5 mm. long, very sparsely pilose with fine hairs; upper (fertile) lemma 1.7 mm. long, elliptical 2:1, stramineous, shining; palea similar, flat; anthers 3, tan, 0.9-1.0 mm. long. Chromosome number $n = 10$ from a Costa Rican specimen.

Rare or overlooked; gallery forests along streams in savannas; Las Animas, Liberia; General Valley; Boruca. Elevations 200-300 m. October to February. Mexico; Costa Rica and Panama.

Panicum helobium Henrard, Meded. Rijks-Herb. Leiden 40:52. 1921. The name has usually been credited to Mez ap. Ekman, Ark. Bot. II, (4):23, pl. 1, fig. 6. 1912. This is, however, a *nomen nudum*. Henrard, although citing Mez, gives a full Latin description.

Duration indefinite; culms long-decumbent, creeping and rooting at the nodes, the decumbent portions branching freely; erect culms unbranched, 10-70 cm. tall; prophylla prominent, broad, up to 5 mm. long; culms glabrous, hollow, ca. 1 mm. thick; nodes dark, not prominent; leaf sheaths mostly shorter than the internodes; glabrous; ligule a brown-

ish membrane, 0.3-0.7 mm. long; blades flat, cordate-based, 2-6 cm. long, 4-11 mm. wide, glabrous or with a few slender elongate hairs on the rounded basal margins. Peduncle exerted up to 10 cm.; panicles solitary, terminal, broadly ovoid, 5-10 cm. long, 5-9 cm. wide, many-flowered; peduncle, rachis, and pedicels glabrous; pedicels elongate, flexuous. Spikelets glabrous, turgid, ovoid to obovoid, usually gaping because of the enlarged palea of the sterile lemma, 1.7-2.0 mm. long; first glume ovate, ca. three-fourths as long as the spikelet, 3- or rarely 4-nerved; second glume and sterile lemma as long as the spikelet, both 5-nerved, or the midnerve frequently suppressed in the sterile lemma; palea of the sterile lemma well developed, ca. as long as the fertile floret and distending the lemma; fertile lemma 1.3-1.7 mm. long, stramineous, faintly striate; palea similar; anthers 3, ca. 1 mm. long.

A Costa Rican specimen of this species in US is *Standley & Valerio 41575*. Prov. San José, vicinity of Santa Maria de Dota, altitude 1,500-1,800 m., swampy woods, ascending, 26 December 1926-3 January 1927. The *Parvifolia* group is a complex of interrelated forms, difficult to distinguish with existing literature. Several chromosome numbers are involved. I have referred Costa Rican material to *P. parvifolium*, *P. errabundum*, and *P. helobium*. A tentative treatment of this group is to be found in J. R. Swallen, Notes on grasses. *Phytologia* 14 (2):65-76. 1966.

***Panicum hirsutum* Swartz, Fl. Ind. Occ. 1:173. 1797.**

Duration indefinite, probably perennial; caespitose in large clumps, 1-2 m. tall; culms simple or branching from middle nodes; prophylla prominent, up to 15 cm. long; internodes up to 1 cm. thick, hollow, glabrous or papillose-hispid just below the appressed-pilose contracted nodes; leaf sheaths mostly overlapping, sparsely papillose-hispid with thick, glassy hairs; dewlap and collar hispid-bearded; ligule a short ciliate membrane, up to 2 mm. long; leaf blades flat, up to 70 cm. long and 25 mm. wide, mostly glabrous, but with a dense patch of long hispid hairs just behind the membranaceous ligule and obscuring it; margins strongly scabrous. Inflorescences terminal on the main culm or a leafy branch; peduncles stout, exerted up to 22 cm.; panicles large, densely flowered, ellipsoidal, 30-50 cm. long, up to 15 cm. wide; branches ascending, naked only near their bases; pedicels short, the lateral ones 0.5-1.5 mm. long, appressed along the panicle branches; spikelets very numerous, densely covering the branches. Spikelets 1.8-2.1 mm. long, glabrous, ovate 2.4-2.7:1, tapering to a rather abrupt point; first glume broadly ovate, acute, 3-nerved, 0.9-1.2 mm. long; second glume and lower (sterile) lemma about equal, as long as the spikelet, exceeding the fertile floret; second glume 7-nerved; sterile lemma 7-9-nerved, enclosing a well-developed palea 1.2-1.5 mm. long; fertile floret 1.3-1.4 mm. long, elliptical 2:1; lemma rigid, shining, the nerves usually visible; palea ca. as long as the lemma, of similar texture; lodicules 2, truncate; anthers 3, purple, ca. 0.7 mm. long; styles 2, separate; stigmas purple; caryopsis whitish, elliptical, ca. 1 mm. long.

Apparently rare, along watercourses on the Caribbean Coastal Plain. Zent Farm, Río Bananito, confluence of Río Puerto Viejo and Río Sarapiquí. February to September. Southern Mexico to Brazil, Ecuador, and Trinidad and the West Indies.

Panicum hirticaulum Presl, Rel. Haenk. 1:308. 1830. *P. pam-pinosum* Hitchc. & Chase, Contr. U.S. Natl. Herb. 15:55. 1910; Fairbrothers, Amer. J. Bot. 40:710. 1953.

Caespitose annual in small clumps; culms 25-80 cm. long, erect or the lower nodes decumbent and rooting, branching freely from lower and middle nodes; prophylla 3-5 cm. long; internodes 1.0-2.5 mm. thick, hollow, papillose-hispid to glabrous; nodes appressed-pilose, not prominent; leaf sheaths mostly longer than the internodes, densely to sparsely papillose-hispid; ligule a minute membrane, densely ciliate with long hairs, the total length 1.5-2.5 mm.; leaf blades flat, 7-27 cm. long, 6-15 mm. wide, papillose-pilose to nearly glabrous. Peduncles papillose-pilose; panicles terminal on the main culms or on leafy branches, open, ovoid, 13-35 cm. long, 2-4 × longer than wide; longest branches up to 13 cm., straight, unbranched and naked below, the spikelets on secondary or tertiary branches appressed to the primary ones on their outer two-thirds. Spikelets glabrous, reddish, 2.4-2.5 mm. long, ovate 3:1, acute; first glume 1.2-1.5 mm. long, 3-5-nerved, ovate 3:1, acute; second glume 2.1-2.2 mm. long, 7-nerved; lower (sterile) lemma 2.2-2.4 mm. long, 9-nerved, enclosing a small membranaceous nerveless palea 0.3-0.8 mm. long; upper (fertile) lemma 1.5-1.8 mm. long, elliptical 2:1, smooth and shining, stramineous; palea similar, flat; anthers 3, orange or reddish brown, 0.9-1.0 mm. long; caryopsis broadly elliptical, white, 1.3-1.4 mm. long.

Bluffs at Playas del Coco; San Luis de Turrubares; Atenas. July to October. Southwestern United States to Panama; western South America to Argentina. Size ranges for spikelets are based on Central American material. Plants from more northerly regions appear to have larger spikelets.

Panicum irregulare Swallen, J. Wash. Acad. Sci. 30:216. 1940. Figure 134.

Duration indefinite; culms extensively creeping and rooting at the lower nodes; flowering branches arising from the rooted nodes, up to 50 cm. long, not observed to branch; attitude not known; culms 1.0-1.5 mm. thick, hollow, glabrous; sheaths mostly shorter than the internodes, glabrous, auriculate, with a few hairs on the auricles; ligules not seen; leaf blades borne on short, thickened, pubescent pseudopetioles ca. 1 mm. long; blades flat, lanceolate, the base somewhat asymmetric, 4.5-7.0 cm. long, 9-15 mm. wide. Inflorescences terminal on the erect branches; peduncle slender, exserted 5-15 cm.; panicle very open, cylindrical, 16-24 cm. long, composed of about 15 slender drooping racemes borne singly or in pairs, remote along the slender rachis; individual racemes 1-2 cm. long. Spikelets paired, unequally pedicellate along the lower sides of the rachis, biconvex, 1.7-2.2 mm. long; disarticulation below the glumes, but the upper floret also freely disarticulating; length 1.7-2.2 mm.; first glume ca. 1 mm. long, ovate, acute, 3-nerved; second glume ca. 2 mm. long, boat-shaped, 5-nerved, acute; lower lemma membranaceous, 2.2 mm. long, ovate, acute, boat-shaped, 5-nerved, its palea ca. 1.4 mm. long, flat or concave, membranaceous, scabrid on the keels; lower flower perfect; anthers 3, tan, 1.1-1.2 mm. long; caryopsis developing, free from the lemma and palea, 0.8 mm. long; upper lemma smooth and shining, dorsally compressed, ovate, acute, ca. 1.4 mm. long, coriaceous, its thickened margins embracing a palea of similar texture.

This peculiar species is known only from the type and one other specimen, probably from the same locality. Type: Stony river bank,



FIG. 134. *Panicum irregulare*. A, growth habit; B, inflorescence; C, spikelet, lateral view; D, spikelet, dorsal view; E, lower floret; F, upper floret.

vicinity of El General, Prov. San José; altitude 760 m. *Skutch 4114*. February 1939.

In the following respects, this species resembles *Pseudechinolaena polystachya*, which grows in the same area: creeping habit, nature of inflorescence, paired spikelets which are biconvex, presence of a palea and stamens in the lower floret, oblique-based lanceolate blades. It differs in the much smaller spikelets which lack the stipitate bristles of *Pseudechinolaena*. In view of its rarity, it may represent a hybrid between this genus and a species of *Panicum*.

***Panicum laxiflorum* Lam., Encycl. Method. Bot. 4:748. 1798. *P. xalapense* H.B.K., Nov. Gen. & Sp. 1:103. 1816.**

Caespitose perennial; plants 10-25 cm. tall, forming dense but soft clumps of many culms; branching freely from the lower and middle nodes; internodes ca. 1 mm. thick, hollow, pilose; nodes retrorsely pilose; leaf sheaths mostly overlapping, densely pilose with spreading or retrorse fine hairs up to 4 mm. long; ligule a sparse to dense row of fine white hairs, 0.2-0.3 mm. long; leaf blades soft, flat, rounded to the base, 3-8 cm. long, 3-7 mm. wide, densely pilose on both surfaces and papillose-ciliate on the margins; blades mostly of the same length and rather densely aggregated, the clumps very leafy, only the primary panicles protruding above the general level. Peduncle of the primary panicle 4-5 cm. long; primary panicles 3-7 cm. long, up to 5 cm. wide, pyramidal, few-flowered, the branches solitary or paired; spikelets borne on diverging pedicels 1-several times as long as the spikelet; rachis and branches softly pilose. Axillary secondary panicles small, few-flowered, partially hidden in the leaf sheaths. Spikelets 2.0-2.2 mm. long, finely pubescent, obovate 1.7-1.8:1; first glume 0.7-1.0 mm. long, 1-2-nerved, ovate 4:3, acute; second glume 1.8-2.1 mm. long, 5-7-nerved; lower (sterile) lemma 1.9-2.0 mm. long, 7-nerved, containing a hyaline palea 0.7-1.2 mm. long; upper (fertile) floret 1.7-1.9 mm. long, elliptic 1.5-1.7:1, stramineous, smooth and shining; palea similar, slightly convex; lodicules 2, truncate; anthers 3, purple, 0.4 mm. long; caryopsis obovate 1.2:1, 1.1 mm. long. Chromosome number $n = 9$ from a Costa Rican specimen.

Occasional, open areas in forests, natural meadows, and road embankments; Cantón de Dota and lower slopes of the Talamanca Range, 1,400-2,600 m. elevation. Probably blooming yearlong, the primary panicles probably produced at the beginning of the rainy season.

This species belongs to the informal group *Laxiflora* of the subgenus *Dichantherium*. In the temperate zone, members of this subgenus produce winter rosettes of short, broad leaves. These are apparently not produced in our species. A number of species have been described which are here included in *P. laxiflorum*.

***Panicum laxum* Swartz, Prodr. Veg. Ind. Occ. 23. 1788. Figure 136.**

Duration indefinite, probably perennial; culms 15-90 cm. long, rarely up to 120 cm., the bases often decumbent and rooting at the nodes, branching from the rooted portion or the middle nodes of erect culms; internodes 1.0-1.5 mm. thick, hollow, glabrous; nodes

glabrous or rarely retrorsely pilose; prophylla ca. 2 cm. long, ciliate on the keels; leaf sheaths shorter than the internodes, the overlapping margin ciliate; surface glabrous or papillose-pilose toward the apex; ligule a thin ciliate membrane, 0.3-0.6 mm. long; leaf blades flat, 6-15 (23) cm. long, 4-12 mm. wide, rather thin, rapidly folding or rolling when the plants are uprooted; dewlap sometimes pilose; upper surface sometimes pilose above the ligule. Inflorescences terminal on leafy culms; panicles usually 5-15 (33) cm. long, open, cylindrical or ellipsoidal, with numerous straight primary branches, densely covered to their bases with spikelets; spikelets short-pedicellate, borne on the lower sides of the triquetrous rachis, in pairs or small groups; larger panicles sometimes with evident secondary branches. Spikelets 1.4-1.8 mm. long, ovoid ca. 2:1, rather blunt, biconvex in lateral view, distended by the enlarged palea of the sterile lemma and often gaping almost to the base; first glume broadly ovate, acute, 3-nerved, 0.7-1.0 mm. long; second glume 1.3-1.8 mm. long, 5-nerved; lower (sterile) lemma similar but 3-nerved, 1.2-1.7 mm. long, with a membranaceous palea 1.3-1.6 mm. long; upper (fertile) floret ovate, 1.2-1.4 mm. long, stramineous; lodicules 2, truncate; anthers 3, yellow or spotted with purple, 0.8 mm. long; styles 2, separate; caryopsis 0.8 mm. long, elliptical, tan. Chromosome number $n = 20$ from numerous Costa Rican specimens.

Common in wet open or partially shaded sites; widespread from sea level to 1,200 m. elevation, rarely higher. Blooming April to October, occasionally during the rest of the year. Southern Mexico to Paraguay; West Indies.

Panicum laxum is a member of the intricate Laxa group. The species of this assemblage are poorly defined and much in need of careful biosystematic study. *Panicum boliviense* may be only a large form of *P. laxum*. *Panicum polygonatum* is also closely related, but has more pointed spikelets lacking a palea in the sterile lemma.

***Panicum maximum* Jacq., Coll. Bot. 1:76. 1786. Figure 135.**

Caespitose perennial in large clumps; plants 1-2.5 m. tall; culms erect, arising from hard scaly bases, simple or sparsely branched from the middle nodes; internodes 3-8 mm. thick, cylindrical, hollow, glabrous or papillose-pilose below the nodes; nodes contracted, appressed-pilose or hispid; sheaths loose, glabrous or more or less papillose or papillose-hispid, especially on the margin and toward the apex; collar and dewlap bearded; ligule a short, thick, ciliate membrane, 1-2 mm. long, with a dense tuft of long white hairs just above it on the upper surface of the leaf blades; blades flat, up to 65 cm. long and 25 mm. wide, mostly glabrous except just behind the ligule; margins with white sclerenchyma bands, coarsely scabrous. Inflorescences terminal on leafy culms; panicle ovoid, 15-65 cm. long; lower branches verticillate, pilose at the base, scabrous, naked near the bases, the longest up to 40 cm. long, ascending; spikelets short-pedicellate in small clusters on secondary branchlets, more or less appressed along the primary branches. Spikelets 3.3-3.6 mm. long, elliptic-obovate ca. 3:1, biconvex, glabrous; first glume rounded, 3-nerved, 1.0-1.2 mm. long; second glume 3.0-3.1 mm. long, 5-nerved; lower (sterile) lemma similar, ca. 3.2 mm. long, 5-nerved, with a thin, membranaceous palea as long or slightly longer; anthers 3, 1.5-1.8 mm. long; upper (fertile) lemma obovate 2.5:1, acute, rigid, stramineous, rugose; palea similar, rugose; lodicules 2, truncate; anthers 3, orange, 1.2-1.8 mm. long; styles 2, naked for the lower half; stigmas purple. Chromosome number $n = 18$ from a Costa Rican specimen.



FIG. 135. *Panicum maximum*. Panicle, plant base, two views of a spikelet, fertile floret.



FIG. 136. *Panicum* species. *P. laxum*: A, blooming culm; B, spikelet, lateral view; C, lower (sterile) floret, showing palea; *P. polygonatum*: D, three views of a spikelet.

Cultivated widely as a forage grass at low elevations, especially near the coasts, and escaping freely to roadsides; mostly below 500 m., but occasionally to 1,100 m. in the Meseta Central. May to November. Native to Africa, but now widely cultivated in tropical and warm temperate countries. The first herbarium collection from Costa Rica dates to 1890. The species is highly apomictic. Local names: *Guinea*; *Pasto Guinea*.

Panicum mertensii Roth in Roem. & Schult., Syst. Veg. 2:458. 1817. *Panicum megiston* Schult., Mant. 2:248. 1824. Figure 137.

Robust erect perennial from a knotty crown; culms up to 3 m. long, unbranched; internodes 4-8 mm. thick, hollow but containing loose masses or diaphragms of aerenchyma, glabrous; leaf sheaths mostly shorter than the internodes, papillose or papillose-hispid, apex auriculate; ligule a thick, erose-ciliate membrane, 2-3 mm. long; leaf blades 30-60 cm. long, 14-25 mm. wide, widest at the middle, glabrous, dark green, the midrib white. Peduncles included or exerted up to 5 cm.; panicles terminal on the culms, open, ovoid, 40-50 cm. long, 17-30 cm. wide; longest branch up to 16 cm. long; branches borne in remote verticels, numerous, straight and stiff, bearing appressed solitary or paired spikelets along the outer half; frequently one member of the spikelet pair reduced or abortive. Spikelets 3.5-4.0 mm. long, obovate, strongly biconvex, glabrous; first glume 1.4-1.7 mm. long, broadly cordate, wider than long, 3-4-nerved; second glume 3.2-3.8 mm. long, 9-nerved; lower (sterile) lemma 3.2-3.7 mm. long, 9-nerved, containing a broad, firm, strongly keeled palea ca. 2.8 mm. long, sometimes with 3 abortive anthers ca. 0.2 mm. long; upper (fertile) floret 2.7-3.0 mm. long, ovate 2:1, acute; lemma smooth, shining, rigid, stramineous; palea similar, convex; anthers 3, purple, 1.4 mm. long; caryopsis ca. 1.6 mm. long, elliptical. Chromosome number $n = 20$ from a Costa Rican specimen.

Rare; shallow water; shady areas at elevations below 100 m.; Hacienda La Taboga, Finca La Taboga, Los Chiles. August to January. Mexico and Guatemala to northern Costa Rica; Panama Canal Zone; Cuba; Trinidad to Paraguay.

This species is tall and conspicuous. Most specimens are only flowering tops and do not include basal portions. Amer. Gr. Natl. Herb. 76 has a large, hard, crownlike base, the culms bearing prop roots from their lower nodes.

Panicum olivaceum Hitchc. & Chase, Contr. U.S. Natl. Herb. 15:225. 1910.

Caespitose perennial in small clumps; winter rosettes not seen; plants 15-42 cm. tall, the culms erect to sprawling, branching freely from most nodes, producing axillary tufts of foliage and small axillary panicles; internodes 1-2 mm. thick, hollow, densely velvety; nodes densely bearded; sheaths shorter or longer than the internodes, densely soft-pubescent; ligule a dense row of white hairs, 2.0-3.5 mm. long, rarely 0.5 mm. long on smaller leaves; leaf blades 2-7 cm. long, 3-9 mm. wide, velvety pubescent on both surfaces, ovate 6-8:1, cordate-based. Peduncle of primary panicle exerted 3-11 cm.; primary panicle pyramidal, 3-7 cm. long, 2-6 cm. wide, many-flowered; spikelets more or

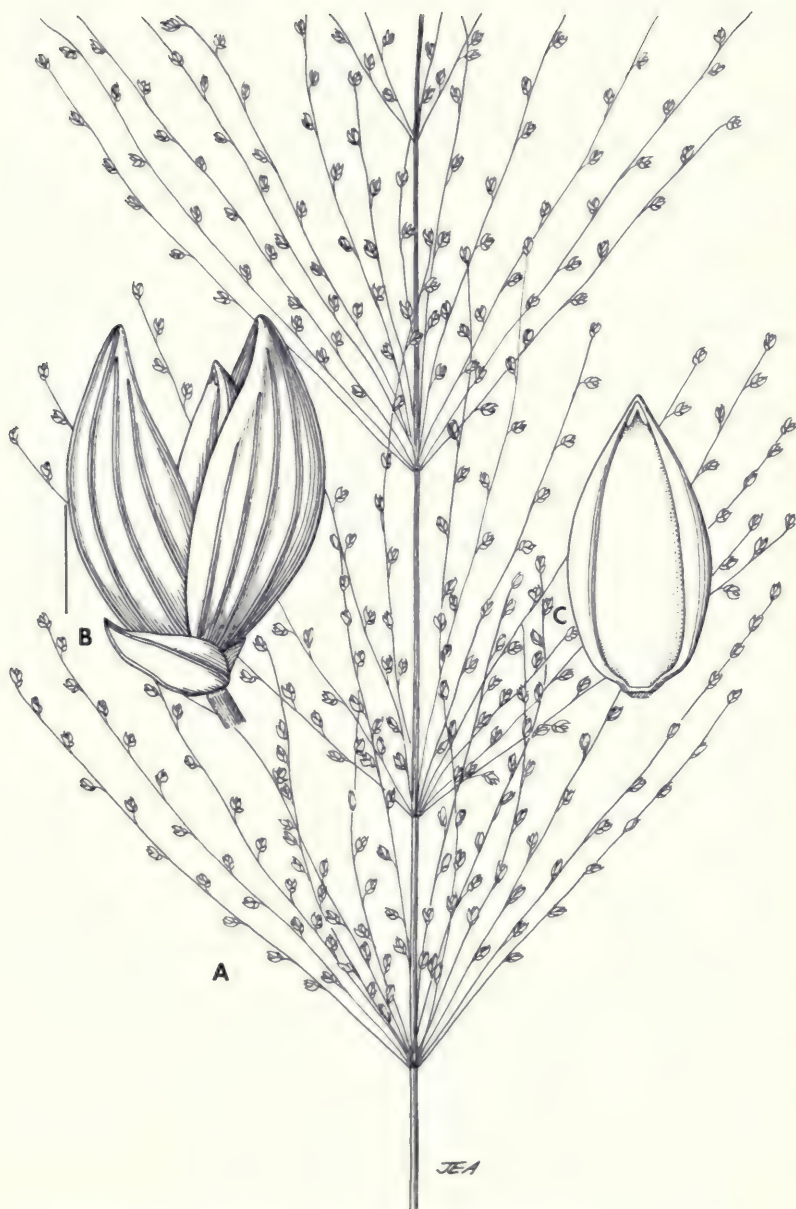


FIG. 137. *Panicum mertensii*. A, panicle; B, spikelet; C, fertile floret.

less appressed along the primary or secondary branches; rachis and peduncle softly pilose; pedicels 1-several times as long as the spikelets. Secondary panicles borne at the tips of the axillary branches, much smaller than the primary panicle, usually few-flowered and with the peduncle included in the uppermost leaf sheath. Spikelets finely pubescent, obovate 2.1-1.3:1, biconvex, usually purple, 1.6-2.0 mm. long; first glume 0.7-0.8 mm. long, broadly deltoid 1:1, the nerves obscure; second glume 1.7-1.9 mm. long, 9-nerved, usually slightly shorter than the fertile lemma; lower (sterile) lemma 1.7-1.8 mm. long, 7-nerved, enclosing a hyaline palea 0.6-0.8 mm. long; upper (fertile) floret elliptical ca. 1.5:1, 1.4-1.6 mm. long, rigid, shining, stramineous; palea similar, slightly convex; anthers 3, purple, 0.7-1.0 mm. long; styles 2, separate; stigmas purple; caryopsis elliptical 1.4:1, white, bearing a red mark near the base on the side opposite the embryo.

Open roadsides and grasslands at intermediate elevations, between 1,000 and 2,200 m.; occasional. Rincón de la Vieja, San Ramón area, Volcán Poás, Volcán Barba, mountains south of the Meseta Central, lower portions of the Cordillera de Talamanca. Apparently blooming yearlong, but the primary panicles produced mostly from June to August.

This species belongs to the subgenus *Dichanthelium*, informal group *Lanuginosa* of Hitchcock & Chase. In our flora, it is most closely similar to *P. viscidellum*, from which it differs in its much smaller size and in chromosome number. Southern Mexico to Venezuela.

***Panicum pantrichum* Hack., Verh. Zool. Bot. Ges. Wien 1915:72 (March). *P. chiriquiense* Hitchc. & Chase, Contr. U.S. Natl. Herb. 17:527. 1915 (July). Figure 138.**

Duration indefinite, probably perennial; plants extensively creeping and forming flat mats, branching freely from the rooted portions; ascending portions of culms 6-25 cm. long, unbranched; prophylla 6-12 mm. long; internodes ca. 1 mm. thick, hollow, softly pilose; leaf sheaths shorter than the internodes, papillose-pilose or papillose-hispid; ligule an erose membrane, 0.2-0.3 mm. long; leaf blades 3.5-8 cm. long, 7-10 mm. wide, asymmetrically ovate 5-8:1, flat, velvety-pilose. Peduncles mostly included or short-exserted; panicles terminal on ascending leafy branches, 2-10 cm. long, 1-8 cm. wide, the larger ones open, pyramidal, the few spikelets appressed along the primary or secondary branches; small panicles partly included in the uppermost sheath, consisting of small clusters of spikelets. Spikelets of both large and small panicles similar, ovate 2:1, pointed, 2.2-2.8 (3) mm. long, the glumes and sterile lemma finely pilose; first glume 1.6-2.3 mm. long, ovate 1.7-1.8:1, 3-nerved; second glume 2.2-2.7 mm. long, 5-7-nerved; lower (sterile) lemma 2.0-2.5 mm. long, 5-6-nerved, the midnerve often suppressed; upper (fertile) floret 1.9-2.2 mm. long, elliptic-obovate 1.7:1, the lemma rigid, shining, stramineous, the back flattened; tip rounded, not apiculate; palea similar, flat; anthers 3, whitish, 0.3 mm. long, remaining trapped within the floret, which is apparently cleistogamous; styles 2, separate; caryopsis broadly elliptical, 0.9-1.4 mm. long, tan to reddish, with a reddish linear mark opposite the embryo. Chromosome numbers $n = 30$ from a Costa Rican specimen and $n = 26$ from a Honduran collection.

Rare; creeping in shade of forests or brush; 1,100-1,700 m. elevation.



FIG. 138. *Panicum* species. *P. pantrichum*: A, blooming plant; B, spikelet; *P. pulchellum*: C, blooming culm; D, spikelet, showing glands on sterile lemma.

San Ignacio, Frailes, Cañas Gordas, 10 km. N of San Ramón. June to October. Honduras and central Costa Rica and Panama to Brazil and Bolivia.

This species is related to *P. cordovense*, but differs in size of plant parts and spikelets, as well as in the velvety foliage. The spikelets appear to be all of one type, whereas those of *P. cordovense* are glabrous in terminal panicles and pubescent in axillary ones. Spikelets of *P. pantrichum* examined appear to be entirely cleistogamous, the small anthers remaining attached to the stigmas on developed caryopses.

Panicum parcum Hitchc. & Chase, Contr. U.S. Natl. Herb. 15:70. 1910.

Duration annual; plants caespitose; culms 50-125 cm. long, erect, usually unbranched; internodes 2-3 mm. thick, hollow, sparsely papillose-pilose; nodes dark, contracted, mostly glabrous; leaf sheaths shorter than the internodes, papillose-hispid; ligule a short membrane 0.2-0.5 mm. long, crowned with a dense row of cilia, in total 1.2-1.3 mm. long; leaf blades 11-35 cm. long, 6-10 mm. wide, more or less papillose-pilose to nearly glabrous, the tip rather abrupt. Peduncles included or exerted up to 9 cm.; panicles terminal, ovoid ca. 2:1, 20-35 cm. long, ca. 12 cm. wide, rather open and few-flowered; branches solitary, 9-18 cm. long; pulvini glabrous. Spikelets solitary on the tips of elongated, stiff pedicels, often purple-marked, 4.7-5.1 mm. long, ovate ca. 3:1, acuminate; first glume 3.1-3.7 mm. long, 5-7-nerved, ovate, acuminate; second glume 3.9-4.7 mm. long, 9-nerved, ovate, acuminate, longer than the lower (sterile) lemma; lower lemma 3.8-4.2 mm. long, 9-nerved, with a narrow, hyaline palea 1.5-1.7 mm. long; upper (fertile) floret 2.8-3.2 mm. long; lemma ovate 2:1, rigid, strongly convex, smooth and shining, stramineous, with a large basal scar; palea similar, flat; anthers 3, 1.2-1.4 mm. long, deep purple; styles 2, separate; caryopsis elliptical, white. The spikelets have a prominent, thick rachilla internode, 0.5-0.8 mm. long, between the first and second glumes.

Rare in Costa Rica; known only from the following two specimens: Prov. Guanacaste, Playas del Coco, bluffs, 14 November 1968, *P. & D. 11437*; 10 km. by road W of Liberia, savannas, 19 December 1974, *Pohl & Lucas 13068*. Western Central Mexico to Honduras, Nicaragua and northwestern Guanacaste. August to December.

The spikelets in the specimens I have seen are somewhat smaller than the range usually assigned to them, but the plants are otherwise typical. *Panicum parcum* was assigned to the informal group *Capillaria* by Hitchcock and Chase. This group was differentiated from the group *Diffusa* on the basis of annual vs. perennial duration. Spikelets and general habit in the two groups are so similar that it is dubious whether they can be maintained. Related species in the Costa Rican flora include *P. ghiesbreghtii* and *P. hirticaulum*.

Panicum parvifolium Lam., Tabl. Encycl. 1:173. 1791. Figure 139.



FIG. 139. *Panicum* species. *P. parvifolium*: A, blooming plant; B, two views of a spikelet; *P. stenodes*: C, blooming culm; D, group of spikelets.

Duration indefinite, probably perennial; culms up to 60 cm. long, the lower parts decumbent and rooting; branching freely from the decumbent portions; internodes less than 1 mm. thick, hollow, glabrous; nodes purple, slightly bearded; sheaths shorter than the internodes, glabrous or more or less appressed-pilose; ligule a thin membrane, ca. 0.2 mm. long; leaf blades flat, often ascending, glabrous or appressed-pilose. Inflorescences terminal on leafy ascending portions of the culms, exserted; panicles broadly pyramidal, very open; 4-7 cm. long, 4-9 cm. wide; branches solitary, spreading; pedicels divaricate, flexuous, $1-3 \times$ as long as the spikelets. Spikelets ovoid-elliptical, plump, less than twice as long as wide, often biconvex, glabrous, 1.4-1.6 mm. long; first glume broadly ovate, often blunt, 3-nerved, 0.9-1.0 mm. long; second glume as long as the spikelet, 5-nerved; lower (sterile) lemma as long as the spikelet, 5-nerved, distended by a well-developed palea of nearly equal length; 3 anthers sometimes present; upper (fertile) floret 1.1-1.5 mm. long, broadly elliptical 7:4, rigid, shining, finely striate, the palea of nearly equal length; anthers 3, purple, 0.9-1.1 mm. long; styles 2, separate; stigmas dark. Chromosome number $n = 18$ from a Costa Rican specimen.

Margins of ponds and streams, often forming large colonies; common around the lagunas near Buenos Aires and near San Isidro de el General and Rivas; Guayabo (Guanacaste). August to January. British Honduras to northern South America, southward to Argentina; West Indies; also reported from tropical Africa.

Panicum parvifolium is a common member of the group *Parvifolia*, composed of slender, hydrophytic species having small spikelets. The plants show much variation, and the group is in need of biosystematic study. See further discussion under *P. helobium*.

***Panicum parviglume* Hack., Oesterr. Bot. Z. 51:429. 1901.**

Perennial, from a hard crown; culms 1 m. or more tall; lower nodes decumbent and rooting; branching from the base; internodes 1.5 mm. thick, solid, sparsely papillose-hispid; nodes contracted, appressed-pilose; leaf sheaths longer or shorter than the internodes, sparsely papillose-hispid; collar hispid-bearded; overlapping margin densely ciliate; ligule a densely ciliate membrane, 0.7-1.0 mm. long; leaf blades flat, 8-20 cm. long, 15-25 mm. wide, ovate 5-8:1, rather abruptly rounded to the asymmetric base; midrib white, prominent beneath; margins strongly scabrous, with conspicuous white marginal sclerenchyma bands; surfaces sparsely papillose-hispid, especially toward the tip. Inflorescences terminal on leafy culms; panicle ca. 20 cm. long, 10 cm. wide, narrowly pyramidal; rachis, branches, and pedicels scabrous; spikelets more or less appressed along primary and secondary branches, their pedicels $1-2 \times$ as long as the spikelets, and with a few fine hairs at the apex. Spikelets elliptical ca. 2:1, 2.2-2.5 mm. long, strongly dorsally flattened, barely acute at the apex, glabrous; first glume a small triangular or cufflike nerveless scale, 0.3-0.5 mm. long; second glume and lower (sterile) lemma subequal, as long as the spikelet, 5-nerved; upper (fertile) floret somewhat shorter, ca. 2 mm. long, broadly ovate 1.5:1, blunt, flattened, stramineous, longitudinally striate; palea similar to the lemma and slightly convex; lodicules 2, truncate; anthers 3, yellow, 1.0 mm. long; styles 2, separate. Chromosome number $n = 18$ from a Costa Rican specimen.

Rare, at scattered localities in the Meseta Central; Guadalupe, Alajuelita, San Miguel; elevation ca. 1,200 m. October to February.

This species grows in brush. It was not collected in Costa Rica after 1912 until our recent collection. Southern Mexico, Guatemala, El Salvador, Costa Rica.

***Panicum pilosum* Swartz, Prodr. Veg. Ind. Occ. 22. 1788, var. *pilosum*. Figure 140.**

Duration indefinite, probably perennial; plants 15-50 cm. tall, the bases sprawling or stoloniferous, rooting at the decumbent nodes; erect branches arising from rooted nodes; prophylla conspicuous, up to 2 cm. long; culm internodes 1-2 mm. thick, hollow, glabrous or papillose-pilose below the nodes; nodes usually densely bearded with spreading fine hairs; leaf sheaths mostly longer than the internodes, often divaricate from the internode and inrolled, appearing somewhat like elongated pseudopetioles, surface nearly glabrous to densely papillose-pilose; ligule absent or represented by a minute ciliolate ridge; collar densely pilose; leaf blades 5-20 cm. long, 7-20 mm. wide, narrowly ovate, the length mostly less than $10 \times$ the width, acuminate, cordate at the base and with a short, broad pseudopetiole; surfaces glabrous to softly pilose. Peduncle exserted 2-15 cm.; inflorescence terminal on erect portions of culms, 6-18 cm. long, narrowly cylindrical, open, composed of 7-27 (50) drooping spikeletlike racemes, these mostly 1.5-2 (6) cm. long. Spikelets solitary, paired, or in trios, the groups alternating on both sides of the midrib of the lower side of the primary panicle branches; pedicels very short; margins of the rachis bearing prominent, papillose-based cilia, 1-3 mm. long. Spikelets 1.4-1.6 mm. long, ovate 2.0-2.5:1, acute, biconvex; first glume 0.6-0.8 mm. long, broadly ovate, acute, 1-3-nerved; second glume and lower (sterile) lemma about equal, as long as the spikelet; second glume 5-nerved; sterile lemma 3-nerved, enclosing a well-developed palea 1.0-1.2 mm. long; upper (fertile) lemma elliptical, 1.2-1.3 mm. long, shining, stramineous, strongly convex; palea similar, flat; anthers 3, purplish, 0.5-0.6 mm. long; styles 2, separate; stigmas dark; caryopsis elliptical, 1.6:1, 0.8 mm. long, amber. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Panicum pilosum is a common weedy species in wet sites, mostly at low elevations; sea level to 800 m., rarely up to 1,200 m. Rain forest margins and clearings, wet pastures and roadsides, coconut groves and beach margins, mostly near the coasts. May to December, possibly yearlong. Southern Mexico to Argentina; Caribbean Islands.

Var. *pilosum* is very similar to var. *lancifolium*, which has the same chromosome number and probably represents a large extreme of the species.

***Panicum pilosum*, var. *lancifolium* (Griseb. ex Hitchc.) Pohl, comb. nov. *P. distichum* Lam., γ *lancifolium* Griseb., Fl. Brit. W. Ind. 548. 1864. *P. distichum*, var. *lancifolium* Griseb. ex Hitchc., Man. Gr. W. Indies 267. 1936. *P. milleflorum* Hitchc. & Chase, Contr. U.S. Natl. Herb. 17:494. 1915.**

Var. *lancifolium* is similar to var. *pilosum* in aspect, inflorescence structure, spikelet size, 3-nerved lower lemma, enlarged palea, and chromosome number. It differs mostly in characters related to plant size and vigor, but there is considerable overlap in most of the measurements. Culms 90-150 cm. long, including the long-decumbent basal portions;

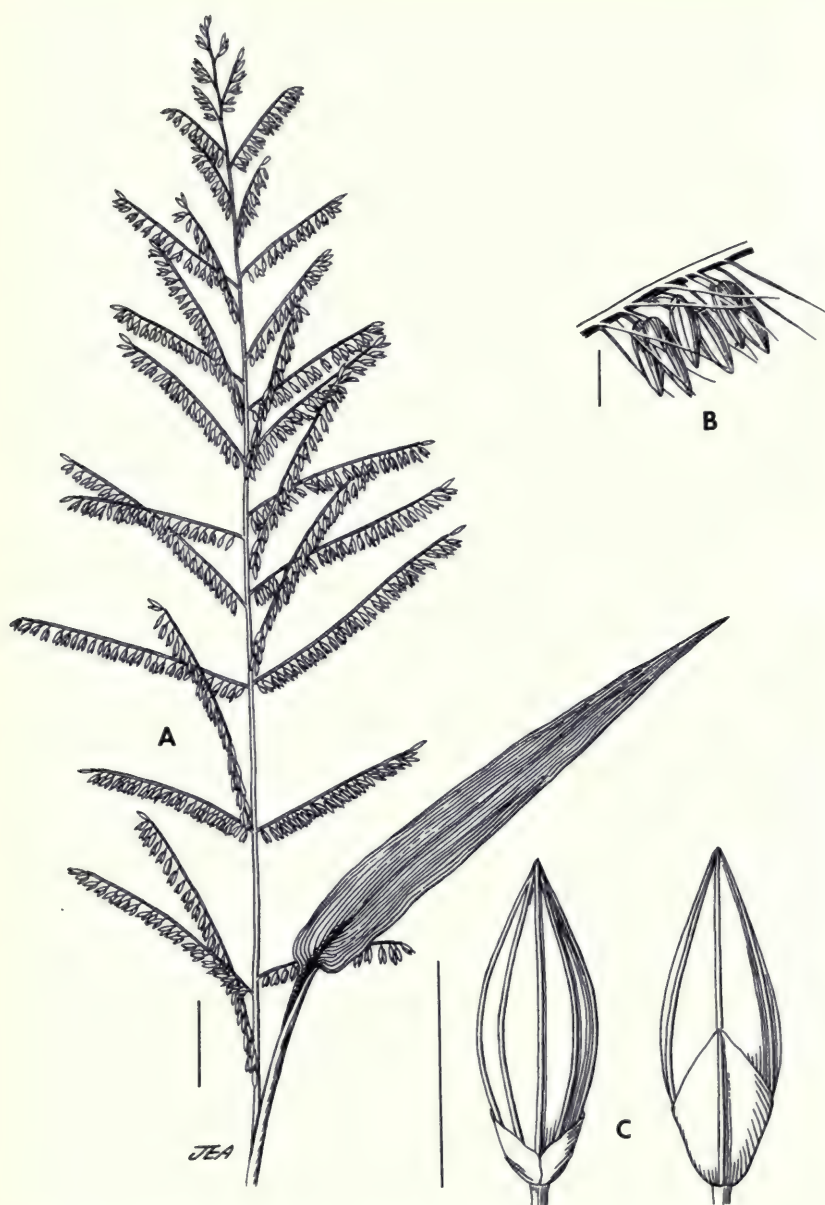


FIG. 140. *Panicum pilosum* var. *pilosum*. A, panicle; B, portion of a panicle branch bearing spikelets; C, two views of a spikelet.

internodes glabrous, 3-4 mm. thick, hollow; nodes bearded or glabrous; leaf blades 15-28 cm. long, 7-18 mm. wide, glabrous or sparsely pilose; ligule absent. Inflorescence 26-35 cm. long, of 40-80 short ascending or spreading 1-sided spikelike racemes, mostly 1-5 (11) cm. long, the lower ones sometimes with secondary branches. Spikelets as in var. *pilosum*. Chromosome number $n = 10$ from a Costa Rican specimen.

Moist forests; Finca la Taboga, Puerto Viejo. August to December. Previously known only from the Canal Zone.

Hitchcock and Chase, in describing *P. milleflorum*, indicated that it was the same as Grisebach's *P. distichum* γ *lancifolium*. *Panicum milleflorum* does not merit separate status as a species, being only a vigorous extreme of *P. pilosum*. Since Grisebach's name has priority at the varietal level, it must be used.

***Panicum polygonatum* Schrad. in Schult., Mant. 2:256. 1824. Figure 136.**

Duration indefinite, probably perennial; culms 25-110 cm. long, the bases long-decumbent and rooting at the nodes; branching freely from the rooted nodes and sometimes from the middle nodes of erect culms; internodes 1.5-2.5 mm. thick, hollow, glabrous or rarely pilose; nodes not prominent, usually retrorsely bearded; leaf sheaths shorter than the internodes, the overlapping edge ciliate, the surface glabrous, occasionally with scattered pilose hairs toward the apex; collar often pilose; ligule a minutely ciliolate membrane, 0.2-0.3 mm. long; leaf blades 5-25 cm. long, 8-15 mm. wide, the base cordate, length 5-9 $\times$ the width; pseudopetiole short, ca. 1 mm. long; surfaces glabrous or with a few pilose hairs on the upper surface above the ligule. Inflorescences terminal on leafy culms; panicles open, narrowly pyramidal, 10-25 cm. long, 3-11 cm. wide, the branches spreading or ascending, the lowermost remote, 3-11 cm. long, the upper branches shorter and closer; spikelets short-pedicellate in pairs or small groups along the lower sides of the triquetrous primary or secondary branches. Spikelets 1.3-1.9 mm. long, ovate 3.1-3.4:1, acute; plano-convex; first glume 0.5-1.0 mm. long, 1-3-nerved, ovate, acute; second glume 1.3-1.7 mm. long, 5-nerved, acute; lower (sterile) lemma 1.2-1.5 mm. long, narrower than the glume, 3-nerved; upper (fertile) lemma 1.0-1.2 mm. long, elliptical 2-3:1, acute, stramineous; palea similar, flat; lodicules 2, truncate; anthers 3, purple, 0.4-0.5 mm. long; styles 2, separate; stigmas purple; caryopsis ca. 0.8 mm. long, plump, tan. Chromosome number $n = 20$ from a number of Costa Rican specimens.

Wet ditches, pond margins, along trails in wet forests; wet sites, mostly near both coasts; usually found from sea level to 300 m. elevation, but occasionally to 1,300 m. June to August, occasionally during the remainder of the year. Southern Mexico to Paraguay.

Panicum polygonatum is a member of the group *Laxa*, related to *P. laxum* and *P. boliviense*, but differing from both in the pointed spikelets and the lack of a palea in the sterile lemma. A single Costa Rican specimen, *P. & D. 10679*, from Laguna de Arenal, has conspicuously pubescent foliage and panicle branches bearing papillose-based cilia. It is otherwise similar to other Costa Rican specimens.

***Panicum pulchellum* Raddi, Agrost. Bras. 42. 1823. Figure 138.**

Duration indefinite, probably perennial; plants extensively creeping and rooting at the prostrate nodes, branching freely; erect portions of the culms 10-30 cm. long; prophylla prominently flanged, 5-15 mm. long; culm internodes less than 0.5 mm. thick, hollow, pilose or glabrous; nodes densely pilose-bearded; leaf sheaths shorter than the internodes, more or less pilose to nearly glabrous; margins ciliate; collar bearded; ligule a minute membrane, 0.3-0.4 mm. long, ciliate or ciliolate; leaf blades flat, thin, obliquely cordate-ovate 3-4:1, 1.8-5.0 cm. long, 4-17 mm. wide; surfaces pilose to glabrous, often with purplish coloration. Peduncles included or exerted to 13 cm.; panicles solitary, terminal on erect portions of the culms, 4-16 cm. long, 2-4 cm. wide, of 6-25 ascending or drooping 1-sided spikelike racemes borne racemosely solitary or in pairs along the rachis; spikelets solitary or paired, short-pedicellate in 2 rows along the lower sides of the rachis. Spikelets finely pubescent, biconvex, acute, 2.0-2.3 mm. long; first glume 0.9-1.2 mm. long, acute, 3-nerved, ovate 2:1; second glume 2.0-2.1 mm. long, 5-nerved; an evident internode between the first and second glumes; lower (sterile) lemma 1.9-2.0 mm. long, 5-nerved, with a well developed palea 1.3-1.6 mm. long, rarely with 3 anthers 0.8 mm. long; back of the sterile lemma usually bearing 2 circular flattened, eyelike glands above the middle, between the midrib and the first pair of lateral nerves; these may be absent, or 1-3 may occasionally be present; upper (fertile) floret 1.1-1.4 mm. long, ovate, the lemma smooth and shining, rigid; palea similar; anthers 3, yellow, 0.6-0.7 mm. long; styles 2, separate; stigmas purple; caryopsis elliptical 2:1, 1 mm. long, white. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Occasional in moist forests, along trails, on forested roadsides, or in brush. Mostly on the Pacific slope, from San Mateo and San Ramón to Turrialba and southward to Cañas Gordas; Meseta Central; La Virgen. Elevations from near sea level to 1,400 m. November to June. Southern Mexico to Bolivia and Brazil; West Indies.

***Panicum rudgei* Roem. & Schult., Syst. Veg. 2:444. 1817. Figure 141.**

Caespitose perennial in dense clumps; culms 75-125 cm. long, erect, spreading, or scrambling in brush, branching freely from the upper nodes; internodes 1.5-3.0 mm. thick, hollow, more or less densely pilose; nodes densely pilose; sheaths densely pilose, longer or shorter than the internodes; ligule a short membranaceous rim, densely ciliate with stiff hairs, in total 1.5-2.0 mm. long; leaf blades rather stiff, pilose, 20-40 cm. long, caudate-acuminate, 8-14 mm. wide. Panicles terminal and axillary from the upper nodes, forming an elongated compound mass, 30-40 cm. long, half or a third as wide; pedicels, especially the terminal ones, much longer than the spikelets. Spikelets ovate, acuminate, 3.0-3.4 mm. long, biconvex, the bracts gaping and exposing the fertile floret, hirsute toward the apex; first glume ovate, acuminate, 2.7-2.9 mm. long, 3-5-nerved; second glume 2.7-2.9 mm. long, 5-7-nerved; lower (sterile) lemma ca. 2.5 mm. long, 7-9-nerved, enclosing a palea of equal length and 3 stamens, the anthers deep purple, ca. 0.6 mm. long; upper (fertile) lemma 1.7-1.9 mm. long, rigid, elliptical 1.6-1.7:1, shining, stramineous; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 0.8-0.9 mm. long. The spikelets are unusual in having definite thick internodes, up to 0.5 mm. long between the glumes and between the florets. Chromosome number $n = 9$ from a Costa Rican specimen.

This species is common on the savannas around Buenos Aires and



FIG. 141. *Panicum rudgei*. A, culm with several panicles; B, C, two views of a spikelet; D, fertile floret.

occurs on the Boruca Savannas as well. Elevations 300-780 m. December to April. Southern Mexico and Guatemala to Panama, Bolivia and Brazil.

***Panicum schiffneri* Hack.**, *Ergebn. Bot. Exped. Akad. Wiss. Suedbras.* 11. 1906.

Caespitose perennial, scrambling in brush, branching freely; internodes 1.5-3.0 mm. thick, solid or hollow with a small lumen, puberulent; leaf sheaths shorter than the internodes, the margin ciliate, the surface puberulent or glabrous; collar bearded; ligule a ciliate membrane, ca. 0.5 mm. long; leaf blades flat, 12-15 cm. long, 13-20 mm. wide, ovate 7-10:1, the surfaces mostly glabrous; base of blades more or less asymmetric, rounded. Peduncles exserted 10-20 cm.; panicles 12-17 cm. long, terminal on leafy culms, very open, 12-16 cm. wide, the longest branch up to 10 cm. long; lower branches solitary and distant, naked below, the spikelets crowded on the outer third; upper branches much shorter; rachis and branches pilose; pedicels short. Spikelets 1.5-1.7 mm. long, elliptical-obovate 1.75-2.0:1, glabrous; first glume a minute nerveless cufflike scale, 0.2-0.4 mm. long; second glume and lower (sterile) lemma equal, as long as the spikelet, 5-nerved; lower floret lacking a palea; upper (fertile) floret broadly elliptical 3:2, blunt, rigid, somewhat flattened; lemma stramineous, finely striate, bearing scattered fine appressed hairs; palea similar; lodicules 2, truncate; anthers 3, orange, ca. 0.5 mm. long; styles 2, separate; stigmas purple; caryopsis 1.0 mm. long, oblong 1.5-2.0:1, tan.

Rare in Costa Rica; known only by the following specimens: Prov. Alajuela, San Miguel de San Ramón, 21 August 1934. *Brenes 19260*. F.; Prov. San José, San Francisco de Guadalupe, *O. Jimenez s.n.* Nov. 1910 US (specimen determined by Chase, but material very inadequate). Southern Mexico to Venezuela and Brazil; West Indies.

***Panicum sellowii* Nees**, *Agrost. Bras.* 153. 1829.

Caespitose perennial from a hard, knotty crown; lower parts of the stems decumbent, rooting at the nodes; culms 100-150 cm. long, weak and scrambling in brush, branching freely, the branches divaricate; internodes 1-2 mm. thick, hollow, glabrous or finely pilose; nodes glabrous to pilose; leaf sheaths shorter than the internodes, or the upper ones overlapping, softly pilose to glabrous, the margin densely pilose-ciliate; ligule a minute membrane, 0.2-0.3 mm. long; collar and auricles pilose; leaf blades ovate 4-8:1, cordate-based, asymmetric, 6-12 cm. long, 7-18 mm. wide, nearly glabrous to velvety-pilose. Peduncles included or short-exserted; panicles terminal on leafy branches, 10-28 cm. long, 4-16 cm. wide, ellipsoidal, very open; branches solitary or paired, straight, ascending or reflexed, the longest ones 5-14 cm. long, nearly simple, spikelet-bearing on the outer half, the spikelets mostly solitary, closely appressed to the branches. Spikelets obovate 2:1, acute, 2.0-2.3 mm. long, usually finely pubescent; first glume ovate 2:1, acute, usually 1-nerved, 1.2-1.5 mm. long; second glume shorter than the fertile floret, 5-nerved, 1.8-2.0 mm. long; lower (sterile) lemma 5-nerved, 1.9-2.2 mm. long, containing a narrow, tongue-shaped hyaline palea 1.0-1.2 mm. long; upper (fertile) floret 1.6-1.9 mm. long, obovate 1.5-2.0:1, acute, the lemma strongly convex, reddish brown, minutely roughened; palea similar, slightly convex; anthers 3, purple, 1.1 mm. long; styles 2, separate; stigmas purple; caryopsis elliptical 3:2, ca. 1.2 mm. long, white. Chromosome number $n = 27$ from a Costa Rican specimen.

Brushy road embankments, bromeliad hedges, forest margins; elevations 600-1,700 m.; occasional; Grecia, Turrialba, Agua Caliente, Frailes, Rivas, Puriscal. July to November. Southern Mexico to Paraguay and Argentina; West Indies.

***Panicum sphaerocarpon* Ell., Bot. S.C. & Ga. 125. 1821.**

Caespitose perennial in erect or sprawling tufts, lacking well-developed basal rosettes; culms 15-45 cm. long; internodes 1.0-1.5 mm. thick, hollow, glabrous, branching from the base and middle nodes; nodes glabrous or upwardly bearded; leaf sheaths longer or shorter than the internodes, glabrous except for fine pilose ciliation on the overlapping margin; ligule a sparse row of hairs, 0.3-0.7 mm. long; lower leaf blades shorter and broader than the uppermost ones; blades flat, cordate-based, firm-textured, glabrous except for a few stiff, pustulose-based elongated cilia on the rounded basal margins of the blades; lower leaf blades 3.0-6.5 cm. long, 8-11 mm. wide, 3-6 × longer than wide; upper blades 3-4 cm. long, 5-8 mm. wide, 4-6 × longer than wide. Peduncles of primary panicles 4-13 cm. long; primary panicles 4-7 cm. long, 3-4 cm. wide, ovoid or pyramidal, the spikelets borne on diverging pedicels; secondary panicles smaller, on shorter branches, their bases often included. Spikelets obovate ca. 1.8:1, brownish or purple, finely puberulent, 1.5-2.0 mm. long; first glume blunt, 0.4-0.7 mm. long, broader than long, usually 1-nerved; second glume 1.5-1.8 mm. long, 5-7-nerved; lower (sterile) lemma 1.5-1.7 mm. long, 5-7-nerved, enclosing a hyaline palea 0.7-0.9 mm. long; upper (fertile) floret 1.4-1.5 mm. long, broadly elliptical 1.5:1, ca. 1.5 mm. long, smooth and shining, stramineous; palea similar, slightly convex; lodicules 2, truncate; anthers 3, purple, 0.4 mm. long; styles 2, separate; stigmas purple; caryopsis broadly elliptical, 1 mm. long, whitish, with a red spot at the base opposite the embryo. Chromosome number $n = 9$ from a Costa Rican specimen.

Occasional; pastures and road embankments; middle elevations, mostly in the mountains south of San José; elevations 1,200-2,700 m.; Aserri, Tarbaca, Copey, Volcán Barba. Probably blooming yearlong. Eastern and southeastern United States, eastern Mexico to northern Panama; Venezuela, Cuba.

This species belongs to the subgenus *Dichanthelium*, a group largely confined to temperate North America. The plants have two blooming periods, the secondary or axillary panicles produced later than the primary ones, and tending to have highly cleistogamous spikelets. In the tropical climates, the plants tend to lack the conspicuous basal rosettes of short, broad leaves that they exhibit in climates with a cold winter. Related species in our flora are *P. laxiflorum*, *P. viscidellum*, and *P. olivaceum*.

***Panicum stagnatile* Hitchc. & Chase, Contr. U.S. Natl. Herb. 17:528. 1915.**

This species has not as yet been collected in Costa Rica, but may be looked for in coastal swamps.

***Panicum stenodes* Griseb., Fl. Brit. W. Ind. 547. 1864. Figure 139.**

Short, densely tufted erect perennial, 15-40 cm. tall; culms unbranched, internodes less than 1 mm. thick, glabrous, hollow; nodes glabrous, inconspicuous; leaf sheaths short, glabrous to softly and densely pilose; ligule a minute membrane, 0.1-0.2 mm. long; leaf blades 2 or 3, flat or involute, 1-8 cm. long, 1.0-1.5 mm. wide, nearly glabrous to papillose-pilose. Peduncles included in the uppermost sheaths; panicles 1-5, exerted from the terminal sheath, 1-2 cm. long, each a slender racemose cluster of a few appressed spikelets. Spikelets obovate 2:1, glabrous, 1.5-2.1 mm. long; first glume triangular 1:1, 0.9-1.2 mm. long, usually 3-nerved; second glume 1.4-1.8 mm. long, 5-(9)-nerved; lower (sterile) floret 1.3-1.8 mm. long, 5-7-nerved, with a hyaline palea ca. 0.5-0.8 mm. long; upper (fertile) floret 1.2-1.7 mm. long, ovate 3:2, stramineous, rigid; palea equal, flat; anthers 2-3, deep purple, 0.4-0.6 mm. long; styles 2, separate; stigmas purple; caryopsis deep purple, elliptical, 0.8 mm. long. Chromosome number $n = 10$ from a Costa Rican specimen.

The delicate, wiry little plants may easily be overlooked. This species has been collected repeatedly on the savannas near Buenos Aires around the ponds. We have a recent collection from the road to Hacienda Las Animas, 2 km. E of the CIA. Dry savannas, elevations from 200-380 m. Probably blooming yearlong, but the inflorescences are very inconspicuous.

The group *Tenera* of Hitchcock and Chase, to which this species belongs, is in need of revision. The exact number of species is debatable. Specimens from Buenos Aires have been variously determined by Hitchcock and Chase as *P. stenodes* and *P. stenodoides* Hubb., although all material that I have seen is very similar. *Panicum tenerum*, which is considerably larger and has more pointed spikelets, has chromosome number $n = 20$. It has not yet been collected from Costa Rica.

***Panicum trichanthum* Nees, Agrost. Bras. 210. 1829. Figure 142.**

Duration indefinite; plants scrambling in brush; culms up to 150 cm. long, branching freely, the lower portions prostrate and rooting at the nodes; internodes smooth and glabrous, hollow, 1.5-2.5 mm. thick; nodes glabrous, dark; prophylla up to 3 cm. long; leaf sheaths shorter than the internodes, glabrous except for the ciliate overlapping margin; ligule a minute membrane, 0.2-0.3 mm. long; leaf blades often with a short pseudopetiole up to 2 mm. long; blades cordate, narrowly ovate 4.5-8:1, 5.5-13 cm. long, 8-23 mm. wide, pilose on the collar, mostly glabrous but occasionally finely pilose on the surfaces. Peduncles included or short-exserted; panicles terminal on leafy branches, open, dome-shaped, 17-27 cm. long, rather delicate, the spikelets borne on elongated flexuous pedicels. Spikelets obovate 2:1, biconvex, 1.2-1.6 mm. long; bracts covered with minute vesicles; first glume 0.2-0.4 mm. long, membranaceous, nerveless; second glume and lower (sterile) lemma about equal, as long as the spikelet; second glume 5-nerved; sterile lemma 3-5-nerved, with a narrow, tongue-shaped palea 0.7-0.8 mm. long; upper (fertile) floret ca. 1.1 mm. long, broadly ovate ca. 2:1, tan; palea similar to the lemma, convex; anthers 3, tan, 0.5-0.8 mm. long; caryopsis broadly oblong 4:3, ca. 0.8 mm. long, tan, opalescent. Chromosome number $n = 18$ from a Costa Rican specimen.



FIG. 142. *Panicum* species. *P. trichoides*: A, blooming plant; B, two views of a spikelet; *P. trichanthum*: C, two views of a spikelet.

The plants clamber in brush or in marsh vegetation; occasional; Finca la Taboga, Lagunas de San Bernardo, Villa Neilly, Santa Rosa (Limón), Limón, Cahuita, Zhorquin. Near sea level to 550 m. elevation, mostly near the coasts. Central Mexico to Paraguay; West Indies.

This species is similar to *P. trichoides* in spikelet structure, but differs in size, leaf proportions, pubescence, and chromosome numbers.

***Panicum trichoides* Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Figure 142.**

Sprawling annual, the culms long-decumbent and rooting at the nodes, forming large patches; erect portions of the culms 10-80 cm. long; branching freely from both decumbent and erect portions; internodes 1-2 mm. thick, hollow, pilose; nodes prominent, covered by the bases of the sheaths; prophylla 1.5-2.5 cm. long; leaf sheaths much shorter than the internodes, copiously papillose-pilose; ligule a short minutely ciliolate membrane, 0.2-0.3 mm. long; leaf blades thin and flat, obliquely cordate-ovate 3-5:1, 3.5-7 cm. long, 5-19 mm. wide, more or less papillose-pilose, the lower margins papillose-ciliate. Inflorescences numerous, terminal on leafy branches; peduncles included or exserted up to 18 cm.; panicles broadly dome-shaped, 4-18 cm. long, 3-11 cm. wide, the longest branch 2-10 cm. long; panicles delicate, lacy, the small spikelets borne on thin, threadlike pedicels much longer than the spikelets. Spikelets obovate 2:1, 1.2-1.3 mm. long, tapering to a slender base, plano-convex, rather thick; bracts finely pilose; first glume narrowly ovate, 0.6-0.7 mm. long, 1-3-nerved; an evident internode, ca. 0.2 mm. long between the first glume and the second; second glume slightly shorter than the spikelet, 1.1-1.2 mm. long, 3-5-nerved; lower (sterile) lemma 1.1-1.2 mm. long, 3-5-nerved, enclosing a tongue-shaped hyaline palea 0.4-0.6 mm. long; upper (fertile) floret 0.9-1.0 mm. long, ovate 2:1, the lemma minutely roughened, tan, strongly convex; palea similar, flat; anthers 3, white, 0.4-0.5 mm. long; caryopsis obovate 2:1, 0.7-0.8 mm. long, opalescent, white. Chromosome number $n = 9$ from a Costa Rican specimen.

Panicum trichoides is a common weed in wet, shaded sites at low elevations, from sea level to 600 m. elevation, rarely to 1,000 m., mostly near the coasts. Blooming mostly from June to October, but to some extent throughout the year. Mexico to Peru and Brazil; West Indies; Tropical Asia.

This species is apparently most closely related to *P. trichanthum*.

***Panicum viscidellum* Scribn., U.S.D.A. Div. Agrost. Circ. 19:2. 1900. Figure 143.**

Perennial; culms 35-110 cm. long, the bases decumbent or rooting; culms erect or spreading, branching from the basal and middle nodes, sometimes producing dense tufts of small branchlets; internodes 1.5-2.0 mm. thick, hollow, papillose-pilose; nodes densely bearded with retrorse or spreading hairs; leaf sheaths shorter than the internodes, pilose; ligule a dense row of short white hairs, 0.5-1.0 mm. long, with much longer hairs on the upper leaf surface behind the ligule; leaf blades flat, soft, cordate-based, 5-12 cm. long, 8-20 mm. wide, more or less pilose on both surfaces. Peduncles exserted up to 22 cm., terminal on the main culms or on leafy branches; primary panicles 5-11 cm. long, 3-9



FIG. 143. *Panicum viscidellum*. A, blooming culm; B, base of plant; C, two views of a spikelet.

cm. wide, dome-shaped, rather dense; branches 1-several per node of the rachis; spikelets appressed along the primary or secondary branches; lateral pedicels ca. as long as the spikelets, the terminal ones much longer. Spikelets obovate 2:1, slightly acute, 1.8-2.0 mm. long, finely pubescent; first glume 0.4-0.7 mm. long, obscurely nerved, ovate 2:1, acute; second glume 1.6-1.9 mm. long, 7-nerved; lower (sterile) lemma 1.6-1.9 mm. long, 7-nerved, enclosing a hyaline palea 0.7-1.1 mm. long; upper (fertile) floret 1.6-1.9 mm. long, elliptical 3:2, the lemma smooth and shining, rigid, apiculate; palea similar, flat; lodicules 2, truncate; anthers 3, 0.9 mm. long, purple; styles 2, separate; stigmas purple; caryopsis broadly elliptical 4:3, 1 mm. long, whitish, with a purplish stain near the base and a red spot near the base on the side opposite the embryo. Chromosome number $n = 18$ from Costa Rican specimens.

Roadsides, river banks, in brush or oak forests; occasional on the Pacific slope, between 700 and 1,600 m. elevation; Volcán Rincón de la Vieja, Zapote (Prov. Alajuela); San Ramón area, Tarbaca, Tejar, lower slopes of the Cordillera de Talamanca. Probably blooming year-long, but primary panicles produced from June to January. Southern Mexico to Colombia.

This species seems to belong to the subgenus *Dichantherium* on the basis of its general morphology. Like other tropical species of this subgenus, it fails to make basal rosettes. Swallen (Fieldiana Bot. 24:268. 1955) lists *P. reflexopilum* Steud., Syn. Pl. Glum. 1:84. 1854. as a synonym of *P. viscidellum*. As this name far antedates *P. viscidellum*, it would have to be used if it could be firmly identified. No type material attributed to this name is in the U.S. National Herbarium, and the notes of Mrs. Chase indicate that she was unable to locate a type in Europe (personal communication from T. R. Soderstrom). The description seems to be applicable to *P. viscidellum*, but in the absence of a type, it seems inadvisable to change the name.

EXCLUDED SPECIES

Panicum altum Hitchc. & Chase, Contr. U.S. Natl. Herb. 17:488. 1915.

This sea coast species was reported from Buenos Aires (*Tonduz* 3619). The specimen is immature and not identifiable. However, *P. altum* grows on coastal sand dunes, an entirely different habitat from the savannas of Buenos Aires.

PARATHERIA Grisebach

Panicle very slender, few-flowered; branches few, simple, strictly erect, deciduous at maturity, each bearing near its base a solitary appressed subsessile spikelet, the branch extending beyond the spikelet as a flattened bristle, tapering to a hispid apex; base of the branch forming an elongated sharp-pointed callus below the point of attachment of the

permanently attached spikelet. Spikelets dorsally compressed, narrowly ovate, acuminate, remaining attached to the simple panicle branch and deciduous with it; glumes equal, blunt, much shorter than the spikelet; lower (sterile) lemma and upper floret about equal; sterile lemma membranaceous; upper (fertile) lemma stiff, acuminate, its margins thin, flat, covering the edges of the palea of similar texture. Lower leaf sheaths often swollen at the base and concealing a solitary cleistogene borne in the axil of an elongated membranaceous prophyllum.

Paratheria is an anomalous panicoid genus, peculiar in its manner of disarticulation and spicate inflorescence. Authors of treatments of African grasses have placed the genus close to *Pennisetum* or *Setaria* because of the sterile, bristle-like branches. The spikelet morphology and cleistogamous habit appear most similar to the tropical American genus *Reimarochloa*. The distribution pattern of *Paratheria* is difficult to interpret, our species occurring in Cuba, Brazil, and tropical Africa, with another species described from Sierra Leone. (Panicoideae: Paniceae.)

***Paratheria prostrata* Griseb., Cat. Pl. Cub. 236. 1866. Figure 143a.**

Duration indefinite; plants caespitose; culms prostrate or ascending, up to 60 cm. long, branching from the base and lower nodes; internodes hollow, glabrous; nodes densely upwardly bearded; prophylla membranaceous, 10-20 mm. long; leaves numerous; leaf sheaths keeled, the lowermost ones densely hirsute, the upper mostly glabrous except near the base; ligule a dense row of white cilia, 0.5-0.7 mm. long; dewlap hirsute; leaf blades flat, 1-3 cm. long, 2-3 mm. wide, the midrib keeled beneath; lower blades hirsute, the upper ones glabrous. Inflorescences terminal on the main culms or on leafy branches; lower leaf sheaths often swollen and concealing solitary cleistogamous fruitful spikelets (cleistogenes); peduncle and lower spikelets of terminal inflorescences included in the uppermost sheath. Inflorescence a spikelike panicle, 6-9 cm. long; branches solitary, simple, 1.5-3 cm. long, flattened or angular, strongly scabrous on the angles, tapering to an acute apex; solitary spikelet attached to the branch near the base on a short pedicel 0.5-1.0 mm. long; branches deciduous from the rachis, the portion below the attachment of the spikelet forming a stiff, acuminate callus. Spikelets narrowly ovate 7-9:1, acuminate, dorsally compressed, 6-9.5 mm. long, glabrous except for a few hairs at the very base; glumes equal, membranaceous, blunt, nerveless, 0.5-0.7 mm. long, or absent from the cleistogenes; lower (sterile) lemma and upper (fertile) floret equally long; sterile lemma lacking a palea, ca. 10-nerved, with 3 closely spaced nerves near each margin; fertile floret with a stiff, smooth, 7-nerved lemma, its margins flat, covering the edges of a palea of similar texture; lodicules 2, truncate; anthers apparently 2, 2-4 mm. long in exerted spikelets, much smaller in the cleistogenes, mostly included, tangled with the stigmas; caryopsis obovate 8:3, blunt, 4.0-4.2 mm. long, tan; style base persistent; embryo conspicuous, ca. 2 mm. long; a red-brown spot at the base of the caryopsis opposite the embryo.

This species was not previously reported from North or Central America. A recent specimen from Buenos Aires, cited below, is the first collection from Central America. Cuba, Dominican Republic; Brazil, Guyana, Colombia; tropical West Africa; Madagascar. Costa Rica: Prov. Puntarenas, Buenos Aires, Osa, elevation 385 m., cre-



FIG. 143a. *Paratheria prostrata*. Plant, inflorescence, and spikelets.

ciendo en la orilla de una charca estacional, *J. G. Laurito* 2642, 5 September 1977 (CR, ISC, F).

PARIANA Aublet

REFERENCES: J. R. Swallen, Eight new species of *Pariana*. *J. Wash. Acad. Sci.* 30:71-78. 1940. T. G. Tutin, A revision of the genus *Pariana* (Gramineae). *J. Linn. Soc. Bot.* 50:337-362. 1936.

Perennial herbaceous grasses; caespitose, or rhizomatous but clump-forming; leaf blades mostly broad, borne on short pseudopetioles. Inflorescences mostly arising directly from the soil on bladeless peduncles, rarely terminal on leafy culms; inflorescence a club-shaped rame of several to many internodes. Pedicellate staminate spikelets borne in verticels of 4-6 at each node of the rachis, the pedicels flattened, coriaceous, and often fused in pairs by their lateral margins; staminate spikelets composed of a pair of flat 1-3-nerved glumes standing exterior to a dorsally compressed awnless floret; stamens 2-many; a single sessile pistillate spikelet concealed within each verticel of staminate spikelets, its glumes herbaceous, equal, 1-nerved, covering the floret; lemma and palea indurate; stigmas 2, barely emerging from the whorl of staminate spikelets.

Pariana is a small genus of herbaceous grasses of wet rain forests from Brazil, Bolivia, and Peru to Costa Rica. Although they are related to the bamboos, they do not form woody perennial culms. Because of their very shaded habitats and inconspicuous basal inflorescences, they are probably overlooked by plant collectors. (Bambusoideae: Parianeae.)

***Pariana parvispica* Pohl, Iowa State J. Res. 47:73. 1972. Figure 144.**

Perennial; rhizomatous, but the culms arising in clumps of few to many from one crown; sterile culms unbranched, arching, 35-50 cm. tall, 1-2 mm. thick, hollow; glabrous except for a single line of puberulence directly below the opening of the next sheath above; nodes densely puberulent with spreading trichomes; lower internodes 6-11 cm. long, bearing bladeless sheaths or small leaf blades, the sheath about one-third as long as the internode; foliage leaves grouped near the tips of the culms; crowded, with overlapping sheaths, the upper internodes 1-2 cm. long, the blades forming a flat spray, simulating a palm leaf; leaves bearing blades usually 6-13 per culm, their sheaths overlapping, glabrous as a whole, but more or less puberulent along the margins near the apex; ligule minute, 0.2-0.3 mm. long, membranaceous, minutely ciliolate, blades of upper leaves 9-13 cm. long, 2-3 cm. wide, glabrous; pseudopetiole 1-2 mm. long, puberulent on its upper surface; auricles prominent, bearing abundant stiff dark bristles 6-12 mm. long, inflorescences normally absent from leaf-bearing stems, but present on *Davidse 1410*, which bears basal aphyllous inflorescences and some apical ones on leafy culms. Inflorescence a thick, club-shaped spicate structure (rame), usually arising directly from the soil, the peduncle bearing 2-3 bladeless sheaths, the uppermost subtending the inflorescence. Rame composed of several cylindrical segments ca. 9 mm. long; each internode bearing at its base a whorl of 3 erect flattened, cartilaginous pedicels, puberulent on their outer faces; pedicels overlapping and forming a continuous sheath around the thin, flattened rachis, nearly as long as the internode; 2 of the pedicels

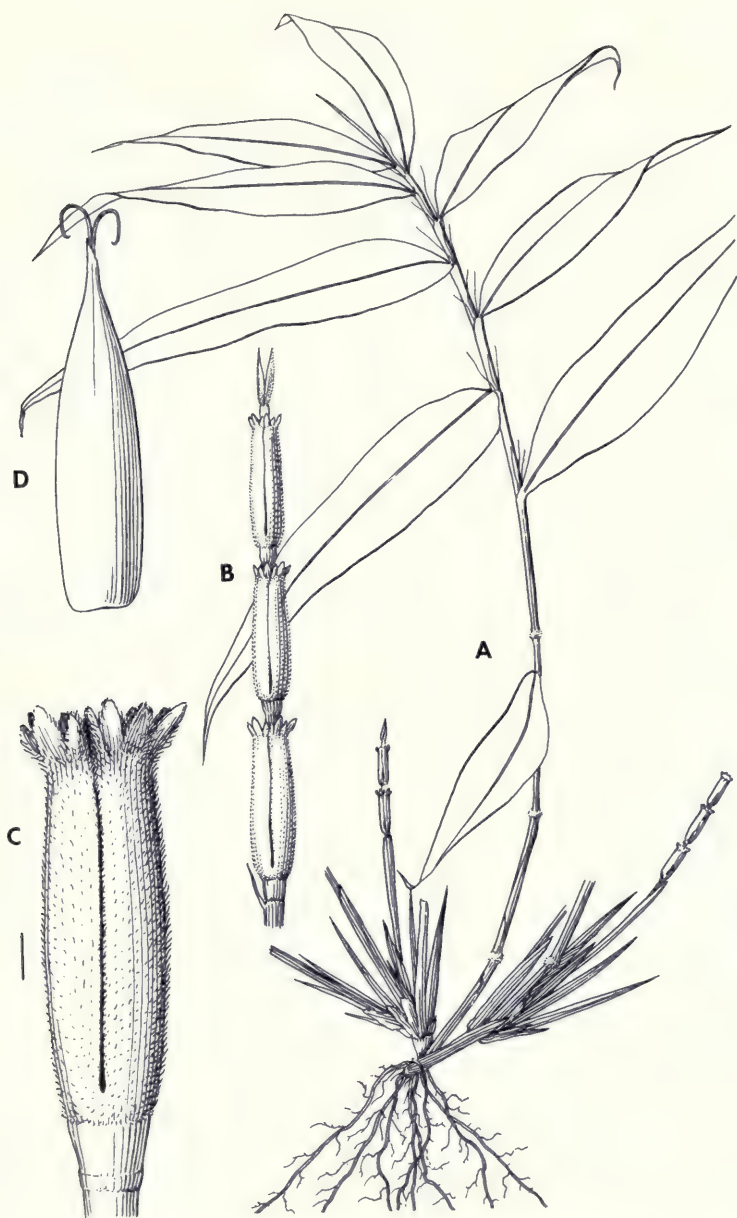


FIG. 144. *Pariana parvispica*. A, habit of plant, with basal inflorescence; B, a rami; C, single segment of a rami, with staminate spikelets at the apex; D, pistillate spikelet.

bearing paired staminate spikelets at their apex, the third with a single staminate spikelet. Each of the 2 sets of paired spikelets has only 3 glumes, 2 being placed at the free margins of the flat pedicel, the third between the 2 spikelets. Solitary spikelet similar to the paired ones, but with 2 equal glumes. Staminate spikelets consisting of the blunt, oblong, stiff, ciliate glumes, ca. 1 mm. long, standing external to a single floret; staminate floret dorsally compressed, awnless, oblong, ca. 1.5 mm. long, lemma puberulent, cartilaginous, very broad, facing outward, its margins inrolled around the edges of the palea; palea smooth, stiffish, 2-nerved, its margins inrolled; flower with 2 broadly spatulate lodicules, thickened above, ca. 1 mm. long; stamens 2, on thick, fleshy, short filaments; anthers slightly exerted through the tip of the floret at anthesis; pollen normal. Pistillate spikelet single at each node, completely concealed by the whorl of flattened pedicels, only the stigmas visible externally, ca. 8 mm. long, dorsally compressed, oval in cross section; glumes oblong, herbaceous, 1-nerved, enveloping the floret, glabrous except for the ciliate margins; lemma and palea coriaceous, equal, tapering to a narrow herbaceous point; lemma very broad, its margins covering the edges of the palea, glabrous; lodicules 3, flat, vasculated, ca. 1-1.5 mm. long, bearing at their tips microhairs with 1, 2, or 3 cells; ovary slender, bottle-shaped, tapering into a stiff style; stigmas 2, short, rather sparsely hairy, extruded through the herbaceous tips of the lemma and palea and emerging from the whorl of pedicels at their apices. The terminal segment of the rame tapers to a point. It consists of 3 sterile flattened overlapping pedicels enveloping a single pistillate spikelet terminal on the end of the rachis. Chromosome number $n = 11$, from microsporocytes of Pohl & Davidse 11646.

Rain forests, lowland Atlantic slope areas. Blooming occurs apparently only during the short-day season, probably from December to February.

This is the most northerly species of the genus *Pariana*. It differs from all of the species of the genus described by Tutin and those described by Swallen in the small size of the inflorescences and various combinations of stamen number, pedicel length and union, and spikelet features. It is difficult to assign *P. parvispica* to any of the sections proposed by Tutin. At the type locality, the plants are abundant over a considerable area of undisturbed rain forest and along the margins of clearings. We have been able to cultivate the plants in the greenhouse, and the chromosome count was obtained from such cultivated plants. This is the species reported by Standley, *Flora of Costa Rica* 85 (1937) as *P. zingiberina* Doell, a South American species, on the basis of sterile material.

PASPALIDIUM Stapf

Rather succulent marsh or aquatic grasses, the culm bases often decumbent and rooting; inflorescences terminal or axillary from upper nodes; inflorescence a slender panicle composed of sessile one-sided racemes, borne singly or in pairs at the nodes of a triquetrous rachis; racemes slender, erect, bearing solitary spikelets in 2 rows along the lower sides of a triquetrous rachis that terminates in a reduced spikelet or a flattened, naked point. Spikelets dorsally compressed, ovate, acute, awnless, placed with the first

glume outward, the second glume turned toward the midrib of the rachis; first glume short, usually blunt; second glume nearly as long as the fertile lemma, which is exposed at the tip; lower (sterile) lemma flat, as long as the spikelet, containing a palea of equal length and usually a staminate flower with 3 anthers; upper (fertile) floret slightly shorter than the lower floret, its lemma elliptical, acute, rugulose, with a prominent areole above the base; margins inflexed over the keels of a similar palea.

A small genus of about 12 species in warm climates, mostly in the Old World. The genus is most closely related to *Brachiaria* and *Urochloa*. (Panicoideae: Paniceae.)

Paspalidium geminatum (Forsk.) Stapf, Fl. Trop. Africa 9:583. 1920. *Panicum geminatum* Forsk., Fl. Aegypt.-Arab. 18. 1775. Figure 145.

Duration indefinite; culms 40-140 cm. long, erect, the bases often long decumbent and rooting; culms unbranched or rarely branched from the middle nodes; internodes glabrous, 3-5 mm. thick, hollow, thick-walled, the wall containing numerous radial chambers separated by thin partitions, each filled with loose stellate parenchyma; nodes glabrous, often contracted; leaf sheaths mostly overlapping, glabrous; ligule a short membrane, densely ciliate, in total 0.7-2.7 mm. long; blades flat or somewhat inrolled, 6-20 cm. long, 5-8 mm. wide, glabrous or minutely scabrous above. Peduncle short, included; inflorescences terminal and sometimes axillary from the uppermost sheath; panicles 10-30 cm. long, very slender, the racemes appressed to the triquetrous rachis; lower racemes distant, up to 5 cm. long, the middle and upper ones progressively shorter and closer, sometimes paired and subopposite, the shortest upper ones less than 1 cm. long; rachis of racemes triquetrous, the angles minutely hirsute or scabrous, spikelet-bearing to the base; spikelets very short-pedicellate, in 2 rows alternating along the 2 lower sides of the rachis. Spikelets disarticulating below the glumes, dorsally compressed, elliptical 1.5:1, acute, mostly 2.0-2.5 mm. long, rarely longer; first glume orbicular, 0.7-0.9 mm. long, thin, faintly 3-5-nerved or apparently nerveless; second glume shorter than the spikelet, 1.7-2.3 mm. long, 5-7-nerved, blunt, sometimes with cross-nerves near the apex; lower lemma 5-nerved, as long as the spikelet, with a palea of equal length and usually a staminate flower, the anthers ca. 1.2 mm. long, orange; upper floret rigid, the lemma 2.2-2.3 mm. long, elliptical 3:2-2:1, strongly rugulose; nerves 5, faint; palea of equal length and similar texture; anthers 3, 1.2-1.5 mm. long, orange; style branches separate, naked at the base; stigmas purple. Chromosome number $n = 27$ from one Costa Rican specimen.

Coastal marshes; Taboga, Hacienda Palo Verde, Boca de Barranca; Río Banano (Limón); elevations near sea level. August to February. Florida and Texas to Brazil and Peru; tropical Africa and Asia.

Specimens with larger spikelets have been assigned to var. *paludivagum* (Hitchc. & Chase) Gould, Southw. Naturalist 15:391. 1971, based on *Panicum paludivagum* H. & C., Contr. U.S. Natl. Herb. 15:32. 1910. Several of our specimens have spikelets approaching the size range of this entity. Chromosome numbers ranging from $n = 9$ to $n = 27$ have been reported for this species, and it is evident that the group is complex and perhaps not yet well understood.

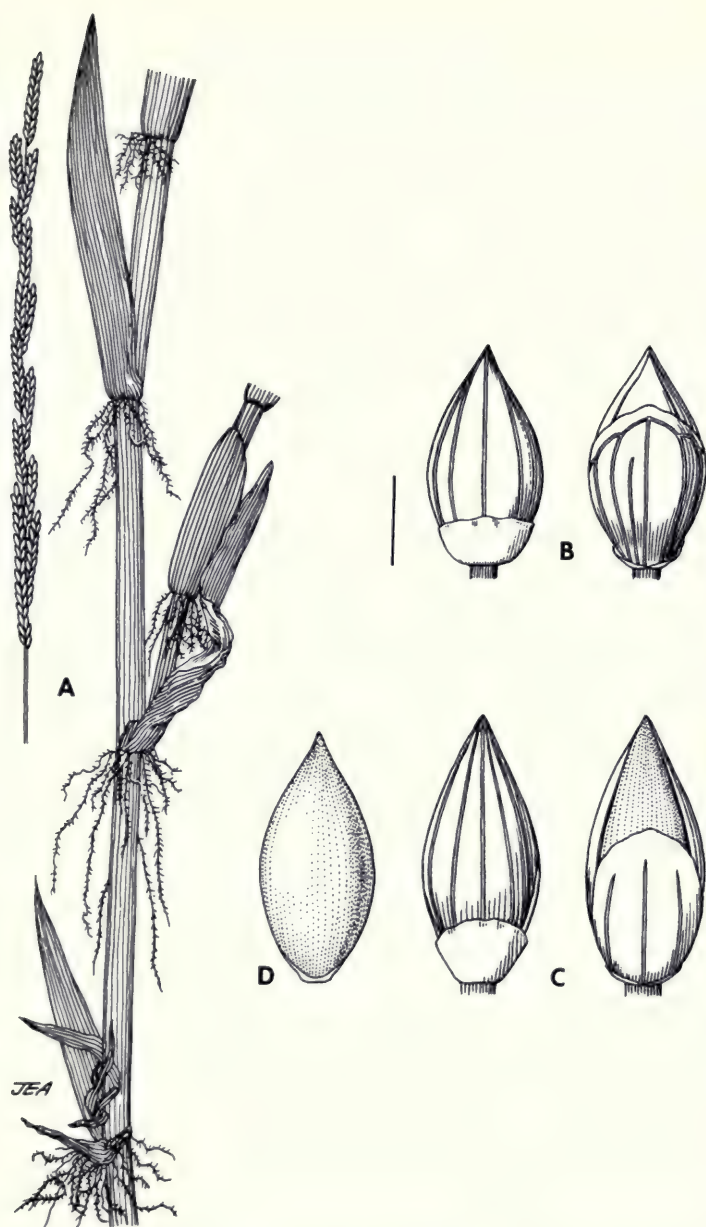


FIG. 145. *Paspalidium geminatum* var. *geminatum*: A, rooting base of culm and inflorescence; B, two views of a spikelet; var. *paludivagum*: C, two views of a spikelet; D, fertile floret.

PASPALUM Linnaeus

REFERENCES: D. J. Banks, Taxonomy of *Paspalum setaceum* (Gramineae). Sida 2:269-284. 1966. Agnes Chase, The North American species of *Paspalum*. Contr. U.S. Natl. Herb. 28:1-310 + XVII. 1929.

Caespitose, rhizomatous, or stoloniferous annual and perennial grasses of extremely diverse size and habit. Inflorescence of 1 or more one-sided racemes, the spikelets short-pedicellate, borne in rows on the lower side of the rachis; spikelets mostly paired, the pairs alternating on opposite sides of the midrib, and the racemes hence 4-rowed, or solitary by absence or abortion of one member of each pair, and the racemes hence 2-rowed. Intermediate conditions also occur, resulting in racemes in part 3-rowed. Rachis triquetrous, or flattened and sometimes winged, the midrib often prominent. Spikelets oriented with the first glume away from the midrib of the rachis and the second glume and the upper (fertile) lemma toward it. Spikelets more or less plano-convex, ovate, elliptical, or obovate in outline, blunt or acute; first glume present on some or all of the spikelets in some species, but absent in most; second glume and lower (sterile) lemma membranaceous, usually equal and as long as the spikelet, covering and concealing the upper (fertile) floret; second glume covering all or most of the convex back of the fertile lemma, entirely absent in a few species; sterile lemma flat, covering the palea of the fertile floret, occasionally with a rudimentary or well-developed membranaceous palea and rarely with a staminate flower; fertile floret usually nearly as long as the spikelet; lemma stiff or rigid, its margins thick and more or less inrolled over the edges of a palea of equal length and similar texture; lodicules 2, truncate; anthers usually 3; styles 2, separate, naked below; stigmas plumose; caryopsis elliptical or obovate, strongly dorsally flattened. The basic chromosome number in the genus is $x = 10$.

Paspalum is a very large genus of grasses of warm climates, its center of diversity being in the American tropics. Relatively few species occur in the temperate zone. Estimates of the number of species range from 200 to 400. The ecological diversity of the genus is extreme. Some species are xeromorphic plants of dry savannas, while others occur in fresh water and salt marshes or as floating aquatics. The Central American species are all confined to low and moderate elevations, rarely above 2,000 m. Some species, as *P. notatum* and *P. dilatatum*, have forage value or are used for erosion control. *Paspalum conjugatum* is a common weed and is regarded as a poor forage species. *Paspalum paniculatum*, *P. candidum*, and *P. plicatulum* are also common and weedy. The genus is related to *Panicum*, differing in its racemose rather than paniculate inflorescences. It is also similar to *Paspalidium* and *Urochloa*, which differ in having transversely corrugated fertile lemmas, and to *Axonopus* and *Brachiaria*, which have the back of the fertile lemma turned away from the midrib of the rachis. Polyploidy and meiotic irregularities occur frequently. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Paspalum*

- 1a. Spikelets (at least one of some pairs) possessing visible first glume 2
- 1b. Spikelets lacking first glume and sometimes lacking both glumes 8
 - 2a. Culms bearing single inflorescence on terminal peduncle, lacking axillary inflorescences 3
 - 2b. Culms bearing axillary as well as terminal inflorescences, sometimes several peduncles arising from terminal sheath 5
- 3a. Tall, stout perennial, culms up to 3 m. tall; inflorescence a panicle of many racemes; spikelets over 3.5 mm. long *P. fasciculatum*
- 3b. Plants less than 1 m. tall, slender; inflorescence of 2-7 racemes 4
 - 4a. Spikelets paired, racemes 4-rowed *P. botterii*
 - 4b. Spikelets solitary, racemes 2-rowed 46
- 5a. Racemes one on each peduncle; sterile lemma usually with well-developed palea (see also *P. setaceum*) 6
- 5b. Racemes several to many on each peduncle *P. setaceum*
 - 6a. Spikelets 2 mm. or less long 7
 - 6b. Spikelets 2.5 mm. or more long *P. pilosum*
- 7a. Both spikelets of each pair with first glumes; spikelets 1.5-1.7 mm. long; racemes up to 3 cm. long *P. decumbens*
- 7b. Lower spikelet of each pair with first glume, upper spikelet lacking one; spikelets 1.7-2.0 mm. long; racemes 3-5 cm. long *P. nutans*
 - 8a. Second glume absent, spikelet consisting only of lower (sterile) lemma and fertile floret; back of fertile lemma completely exposed 9
 - 8b. Second glume present, covering all or most of back of fertile lemma ... 11
- 9a. Racemes falling from central axis of inflorescence entire, with spikelets attached; spikelets whitish or green 10
- 9b. Racemes persistent on plant, only spikelets falling; sterile lemma of spikelets yellow or purple *P. pulchellum*
 - 10a. Sheaths strongly scabrous; spikelets up to 2 mm. long *P. scabrum*
 - 10b. Sheaths not scabrous; spikelets over 2 mm. long *P. candidum*
- 11a. Rachis of individual racemes broad and thin, 2-8 mm. wide 12
- 11b. Rachis of individual racemes less than 2 mm. wide 14
 - 12a. Low, stoloniferous plants of wet sites; foliage glabrous ... *P. acuminatum*
 - 12b. Erect caespitose plants of dry savannas; foliage pubescent 13
- 13a. Spikelets 4.5-6.7 mm. long, cordate at base; second glume strongly pectinate-ciliate, broadly winged; rachis 2.0-2.5 mm. wide *P. pectinatum*
- 13b. Spikelets 3.0-3.2 mm. long, not cordate-based or winged; rachis 5-8 mm. wide *P. stellatum*
 - 14a. Mature fertile lemma stramineous 19
 - 14b. Mature fertile lemma reddish, chestnut-colored, or brown 15
- 15a. Plants low, stoloniferous; spikelets 1.2 mm. or less long *P. orbiculatum*
- 15b. Plants erect or sprawling, not stoloniferous; spikelets at least 1.5 mm. long . 16
 - 16a. Culms tall, stout, 80-250 cm. long; racemes 4-18 cm. long; spikelets 2.6-3.2 mm. long, puberulent, apex with fringe of short hairs *P. virgatum*
 - 16b. Culms slender, 20-150 cm. long; racemes 3-6 (11) cm. long; spikelets 1.8-2.8 mm. long, glabrous or appressed-pubescent, not fringed at apex 17

- 17a. Central part of sterile lemma with transverse wrinkles; anthers over 1 mm. long
P. plicatulum
- 17b. Central part of the sterile lemma flat, not wrinkled; anthers less than 1 mm. long 18
- 18a. Spikelets appressed-pubescent, nearly circular in outline, length less than 1.3 $\times$ width; spikelets usually paired, raceme 4-rowed *P. convexum*
- 18b. Spikelets glabrous, obovate, length 1.3-1.5 $\times$ width; spikelets solitary, racemes 2-rowed *P. centrale*
- 19a. Spikelets densely silky with long white hairs up to 6 mm. long borne on second glume; inflorescences large, fan-shaped, of numerous racemes
P. saccharoides
- 19b. Spikelets glabrous or pubescent, sometimes ciliate, but not concealed with long, white hairs; inflorescences various 20
- 20a. Racemes falling from common rachis as units, with spikelets attached to flattened rachis; creeping or floating aquatic *P. repens*
- 20b. Racemes persistent on common rachis, spikelets falling from axis; plants of wet or dry habitats 21
- 21a. Spikelets 2 mm. or less long 22
- 21b. Spikelets more than 2 mm. long 33
- 22a. Spikelets 0.6-0.7 mm. long *P. parviflorum*
- 22b. Spikelets at least 1 mm. long 23
- 23a. Raceme solitary on each peduncle *P. nutans*
- 23b. Racemes 2 or more on each peduncle (rarely 1 in depauperate individuals) ... 24
- 24a. Racemes numerous (7-70), forming a panicle 25
- 24b. Racemes usually 2-5, rarely solitary or as many as 8 26
- 25a. Spikelets blunt or barely acute, length 1.4 $\times$ width or less; rachis of racemes 0.5 mm. or less wide; racemes 18-70 per panicle *P. paniculatum*
- 25b. Spikelets acute, length 1.5 $\times$ width or more; rachis of racemes 0.6-0.8 mm. wide; racemes 30 or fewer *P. microstachyum*
- 26a. Plants strongly stoloniferous; racemes 2, conjugate, very slender; spikelets solitary, second glume silky-ciliate, especially toward apex *P. conjugatum*
- 26b. Plants not stoloniferous; racemes 1-several; spikelets glabrous or pubescent but not silky-ciliate 27
- 27a. Plants with solitary terminal inflorescences and lacking axillary inflorescences 28
- 27b. Plants with terminal and axillary inflorescences from terminal sheaths and sometimes from lower sheaths *P. setaceum*
- 28a. Spikelets solitary, racemes 2-rowed 29
- 28b. Spikelets paired, racemes 4-rowed 31
- 29a. Spikelets bearing minute globular hairs; plants caespitose annuals *P. multicaule*
- 29b. Spikelets glabrous; plants caespitose or rhizomatous perennials 30
- 30a. Plants rhizomatous, forming open patches on wet mud 45
- 30b. Plants densely caespitose, forming flat mats on soil *P. pumilum*
- 31a. Spikelets bearing minute glandular hairs; racemes paired (rarely 3) conjugate
P. clavuliferum
- 31b. Spikelets glabrous; racemes 1-6 32
- 32a. Racemes 4-6; spikelets 1.5-1.8 mm. long *P. squamulatum*

- 32b. Racemes 1-3; spikelets 1.0-1.1 mm. long; fertile lemma finely tuberculate
P. pictum
- 33a. Spikelets silky-ciliate 34
- 33b. Spikelets glabrous or pubescent, but not conspicuously ciliate 36
- 34a. Spikelets broadly ovate, length ca. $1.5 \times$ width *P. dilatatum*
- 34b. Spikelets ovate, acute, length at least $2.3 \times$ width 35
- 35a. Spikelets mostly paired, racemes 4-rowed; leaf blades ovate, cordate-based, $6-12 \times$ longer than wide; racemes 1-5 *P. humboldtianum*
- 35b. Spikelets solitary, racemes 2-rowed; leaf blades linear, usually $20-50 \times$ longer than wide; racemes 8-33 *P. fasciculatum*
- 36a. Spikelets 4.3-5.0 mm. long, acute, narrowly elliptical, at least $2.6 \times$ longer than wide; rare; savannas of General Valley *P. lineare*
- 36b. Spikelets less than 4 mm. long, variously shaped 37
- 37a. Racemes usually 2, conjugate, sometimes a third below 38
- 37b. Racemes 5 or more, borne along common rachis 42
- 38a. Plants extensively stoloniferous, growing in wet areas 39
- 38b. Plants erect or sprawling, but not stoloniferous; plants of various habitats 40
- 39a. Spikelets glabrous; plants of sea beaches *P. vaginatum*
- 39b. Spikelets with pubescent sterile lemmas; moist areas in interior .. *P. distichum*
- 40a. Plants arising from thick, woody, scaly rhizomes; spikelets at least 3.5 mm. long *P. notatum*
- 40b. Plants lacking rhizomes; spikelets less than 3 mm. long 41
- 41a. Spikelets nearly circular, blunt; bracts tan, mottled, or streaked with brown
P. serpentinum
- 41b. Spikelets ovate, acute; bracts uniformly green or tan *P. minus*
- 42a. Spikelets glabrous, solitary, racemes 2-rowed *P. reclinatum*
- 42b. Spikelets pubescent or glabrous, paired, racemes 4-rowed 43
- 43a. Racemes 5-8 in each inflorescence 47
- 43b. Racemes 15-150 in each inflorescence 44
- 44a. Culms erect, unbranched; basal leaf sheaths strongly keeled, closely overlapping, forming flat fans; spikelets obovate, ca. $1.5 \times$ longer than wide, purple, glabrous or nearly so *P. turritiforme*
- 44b. Culms becoming branched; basal sheaths not strongly keeled; spikelets obovate, ca. $2 \times$ longer than wide, mottled brown and tan, puberulent
P. corypheum
- 45a. Anthers pink, ca. 0.6 mm. long, sterile; endemic to Las Playitas del Río Bebedero *P. jimenezii*
- 45b. Anthers purple, 0.8-0.9 mm. long, producing pollen *P. standleyi*
- 46a. Plants stoloniferous; spikelets acute, 2.7-3.2 mm. long *P. distichum*
- 46b. Plants caespitose; spikelets blunt, less than 2 mm. long *P. pumilum*
- 47a. Leaf blades ovate, widest near middle, $5-8 \times$ longer than wide, 1-2.5 cm. broad; racemes 4-7 cm. long, rachis green; spikelets minutely appressed-pubescent
P. costaricense
- 47b. Leaf blades linear, 1 cm. or less wide; racemes 3-5 cm. long, rachis deep purple; spikelets glabrous or nearly so, purple *P. tonduzii*

***Paspalum acuminatum* Raddi, Agrost. Bras. 25. 1823. Figure 146.**

Duration indefinite, probably perennial; culms long decumbent and rooting from the lower nodes, often trailing in water; erect portions 35-65 cm. long; culms branching freely from the decumbent portions; internodes 1.0-1.5 mm. thick, solid, glabrous; nodes glabrous, not prominent; leaf sheaths shorter or longer than the internodes, glabrous; ligule a thin membrane, 1-2 mm. long, decurrent on the sheath margins; leaf blades 3-13 cm. long, 4-12 mm. wide, glabrous, ovate, rounded abruptly to the base. Inflorescences terminal on leafy erect branches, occasionally axillary; peduncles included or exserted to 5 cm.; racemes 1-5 on a short rachis; individual racemes 2.5-5.0 cm. long, borne on a short peduncle 1-2 mm. long; rachis flat, foliaceous, 2.5-3.0 mm. wide, scabrous on the margins, bearing a single protruding spikelet on the tip; spikelets alternating in 2 rows; pedicels short, angular. Spikelets strongly dorsally flattened, ovate 2.5:1, 3.2-4.0 mm. long, short-acuminate; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, thin and membranaceous, glabrous, 5-nerved, the lateral nerves paired and close to the margins; upper (fertile) floret 0.4-0.8 mm. shorter than the outer bracts, 2.4-3.0 mm. long, obovate 1.7-2.1:1, blunt, strongly dorsally flattened, stramineous, finely roughened, bearing a group of minute cilia at the apex; palea similar and of equal length, flat; lodicules 2, truncate; anthers 3, purple, 1.0-1.2 mm. long; styles 2, separate; stigmas purple. Chromosome number $n = 20$ from two Costa Rican specimens (reported originally as *P. serratum*).

Province of Cartago, near Paraíso and Peralta; margins of shallow ponds; elevations 700-1,100 m. October to March. Louisiana and Texas to Argentina.

This species and *P. serratum* H. & C. are very similar and differ mostly in vegetative vigor. I believe that all of our Central American specimens represent one species. We have abundant material from Honduras which matches the Costa Rican specimens in all respects but general vegetative size and vigor.

***Paspalum botterii* (Fourn.) Chase, J. Wash. Acad. Sci. 13:436. 1923. *Dimorphostachys botterii* Fourn., Mex. Pl. 2:14. 1881. Figure 147.**

Caespitose perennial from a knotty crown; plants 40-110 cm. tall; culms simple or sparingly branched; internodes 1-3 mm. thick, hollow, glabrous; nodes glabrous or appressed-bearded, dark; leaf sheaths mostly overlapping, keeled, sparsely to densely papillose-hispid, collar bearded, overlapping margin ciliate; ligule a thin brown membrane, 1.0-1.5 mm. long; a row of stiff elongate hairs just behind the ligule; larger leaf blades 17-44 cm. long, 12-24 mm. wide, ovate 9-23:1, the base of the blade usually cordate, sometimes the lower blades tapering to the base; blades flat, lax, more or less papillose-pilose on both surfaces; midrib broad, white, keeled beneath. Inflorescences terminal on leafy culms, 10-32 cm. long; panicle of 3-7 slender racemes borne racemosely along an angled central rachis; individual racemes ascending, 5-20 cm. long; rachis of racemes ca. 1.0 mm. wide, flat, the midrib not conspicuous, the margins raised, sometimes ciliate; spikelets paired on each side of the midrib, crowded. Spikelets brownish, puberulent, 2.2-2.5 mm. long, obovate 1.4-1.6:1, blunt, dimorphic; first glume usually absent in the terminal spikelet of each pair, present or absent in the lower spikelet; first glume, when present, narrowly triangular, acute, 1-nerved, up to 1.6 mm. long; second

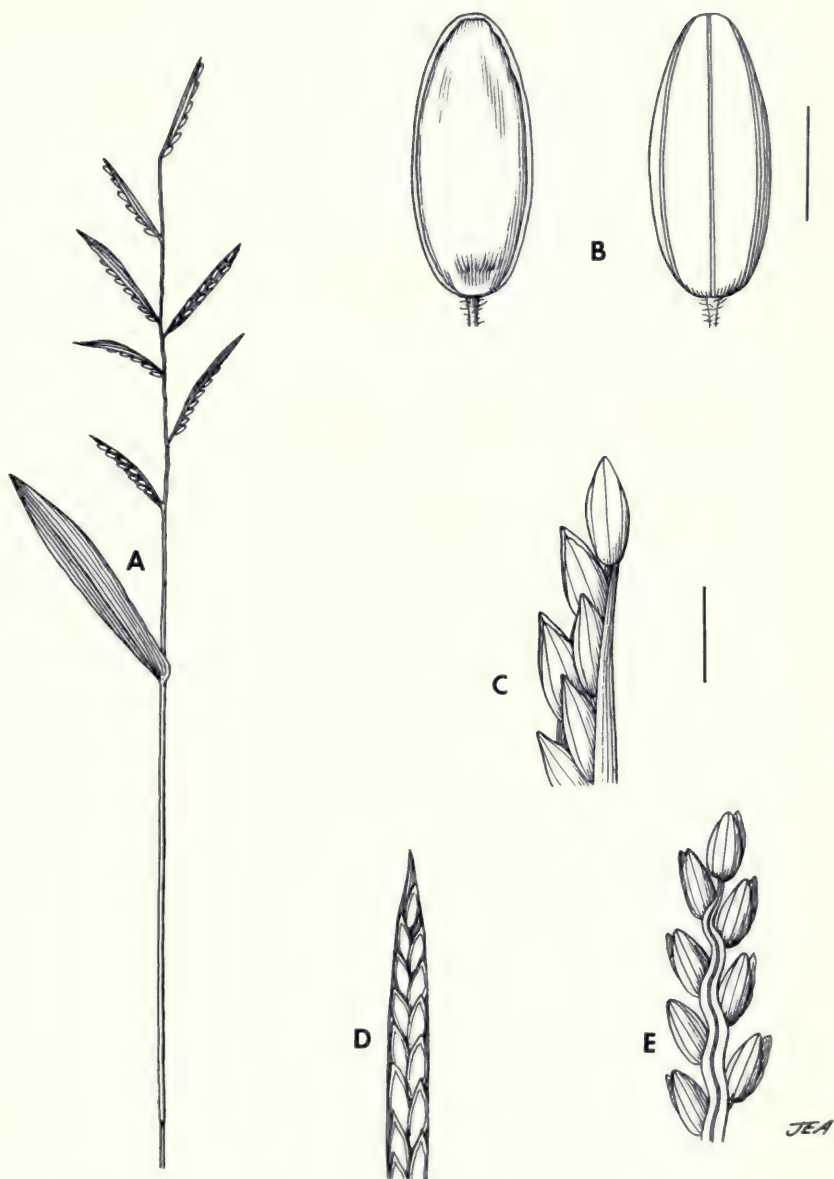


FIG. 146. *Paspalum* species. *P. candidum*: A, inflorescence; B, two views of a spikelet; *P. acuminatum*: C, raceme apex with spikelets; *P. repens*: D, raceme apex with spikelets; *P. reclinatum*: E, raceme apex with spikelets.



FIG. 147. *Paspalum botterii*. Inflorescence, spikelets, fertile floret.

glume 3-5-nerved, slightly shorter than the fertile floret, which is exposed at the tip; lower (sterile) lemma as long as the spikelet, 3-5-nerved; upper (fertile) floret 2.2-2.4 mm. long, elliptic-obovate; lemma whitish, finely striate, convex; palea similar, flat; anthers 3, purple, 0.7-1.0 mm. long; styles 2, separate; caryopsis (one individual) 1.2 mm. long, elliptical 1.2:1, tan. Chromosome number $n = 40$ from Costa Rican specimens.

Dry savannas, roadsides, forest margins, beaches; occasional in northern Guanacaste, mostly near the Pacific Coast; sea level to 250 m. elevation; Playas del Coco, Playa Tamarindo, Puerto Castillo, Hacienda Palo Verde, Bagaces, Finca la Pacifica. Blooming June to December. Central Mexico and Guatemala to northwestern Costa Rica.

This species is similar to *P. costaricense*, from which it differs in the longer and narrower leaf blades, pubescent sheaths, the presence of a first glume, and in chromosome number. The species is named for Matteo Botteri.

Paspalum candidum (Humb. & Bonpl.) Kunth, Mém. Mus. Hist. Nat. 2:68. 1815. *Reimaria candida* Humb. & Bonpl. in Flügge, Monogr. *Paspalum* 214. 1810. Figure 146.

Sprawling or decumbent annual, the lower portions of the culms prostrate and rooting; upper portions erect or scrambling or leaning in brush; culms branching freely, especially from decumbent nodes; internodes 1-2 mm. thick, hollow, thin-walled, glabrous; nodes dark, often prominent, rarely slightly pubescent; leaf sheaths glabrous or the overlapping margin finely ciliate; ligule a ciliolate, sometimes puberulent membrane, 1-2.8 mm. long; leaf blades flat, thin, 4-10 cm. long, 8-21 mm. wide, broad-based, ovate 3-5:1, tapering abruptly to an acute apex, glabrous to finely pilose on one or both surfaces. Peduncles terminal on leafy branches, included or exserted up to 5 cm.; rachis 7-11 cm. long, flattened or triquetrous, glabrous or puberulent, bearing 6-23 ascending or drooping racemes, these 1-3 cm. long, falling as units from the rachis; racemes pilose at the base; rachis of racemes flattened, membranaceous, ca. 2 mm. wide, bearing spikelets from the base but extending beyond the terminal spikelet as a flat point; spikelets solitary, in 2 rows or occasionally 1 row, on very short pilose pedicels on the lower (abaxial) surface of the rachis and partially concealed by it. Spikelets whitish or rarely purplish, ovate-elliptical 1.8-2.1:1, blunt, 2.1-2.4 (2.7) mm. long; first and second glumes absent; lower (sterile) lemma flat, membranaceous, faintly 3-nerved; as long as the spikelet; upper (fertile) floret 2.0-2.3 (2.6) mm. long, the lemma smooth and shining, firm but not rigid; palea similar and of equal length, flat; lodicules 2, truncate; anthers 3, 1.1-1.5 mm. long, yellow, sometimes suffused with purple near the base; styles 2, separate; stigmas dark. Chromosome number $n = 30$ from Central American specimens.

Wet open or partially shaded areas; pastures, road ditches, cornfields, river banks; elevations 1,200-2,300 m.; common in the Meseta Central and occasional elsewhere at intermediate elevations in the mountains, Monteverde, Poás, Irazú, Cordillera de Talamanca. August to February. Southern Mexico to Chile.

Paspalum candidum is the most common Costa Rican member of

the informal group *Dissecta* of Chase, which also includes, in our flora, *P. scabrum*, *P. prostratum*, *P. reclinatum*, and *P. acuminatum*. This group of species are mostly plants of wet habitats, having broad, foliaceous raceme rachises. Although all of our Central American chromosome counts for *P. candidum* indicate $n = 30$, counts from Venezuela of plants that are very similar morphologically indicate a diploid strain with $n = 10$ exists there.

Paspalum centrale Chase, J. Wash. Acad. Sci. 17:145. 1927. Figure 148.

Plants caespitose, annual in cultivation, 30-85 cm. tall; culms erect or the bases decumbent, branching from the lower and middle nodes; prophylla 4-6 cm. long; internodes 1.0-2.5 mm. thick, hollow, thick-walled, glabrous; nodes glabrous; leaf sheaths keeled, loose, usually longer than the internodes, sparsely to densely papillose-pilose; ligule a thin brown membrane, 3-4 mm. long; leaf blades linear, 9-24 cm. long, 3-11 mm. wide, sparsely to densely papillose-pilose; midrib keeled beneath; base slightly wider than the apex of the sheath; uppermost leaf blade reduced or obsolete. Peduncles exerted up to 5 (12) cm.; inflorescences terminal on leafy branches, 4-12 cm. long, the common rachis flattened and channeled, glabrous, 1.5-8 cm. long; racemes 1-9, solitary, racemose along the central rachis; individual racemes 2-6 (9) cm. long, with a tuft of elongate hairs at the base; rachis 1.0-1.3 mm. wide, zigzag, with a prominent midrib; spikelets usually solitary, in 2 rows, occasionally some of them paired and the raceme 3- or 4-rowed. Spikelets 2.0-2.5 mm. long, obovate 1.3-1.5:1, blunt, glabrous, grayish-green; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, thin, 4- or 5-nerved, the lateral nerves close to the margin, the sterile lemma smooth, not wrinkled as in *P. plicatum*; upper (fertile) floret very slightly shorter than the spikelet, chestnut brown, plano-convex; lemma finely striate, the nerves evident; palea similar, flat; lodicules 2, truncate; anthers 3, yellow or purple-tipped, 0.8-0.9 mm. long; styles 2, separate; stigmas purple; caryopsis broadly elliptic, ca. 1.8 mm. long, dark-streaked, with a purplish spot opposite the embryo. Chromosome number $n = 30$ from Costa Rican and Salvadorean specimens.

Dry pastures, savannas, dry lake bed; sea level to 500 m. elevation; occasional in northwestern Guanacaste; Hacienda Murcielago, Finca La Cuera, Finca La Pacifica, Viente Siete, Puntarenas, Atenas. Blooming from July to October. Coastal El Salvador to Panama.

This species is very similar to *P. plicatum*, differing mostly in the broader rachis of the racemes, narrower spikelets, smooth sterile lemma, and annual habit.

Paspalum clavuliferum Wright, Anales Acad. Ci. Méd. Habana 8:203. 1871. *Paspalum pittieri* Hack. in Beal, Gr. N. Amer. 2:88. 1896. Figure 149.

Small caespitose annual in small tufts; plants 10-30 cm. tall, erect; culms branching from the base and middle nodes; internodes slender, less than 1 mm. thick, hollow, glabrous; nodes glabrous; prophylla 13-18 mm. long; foliage mostly crowded on the lower

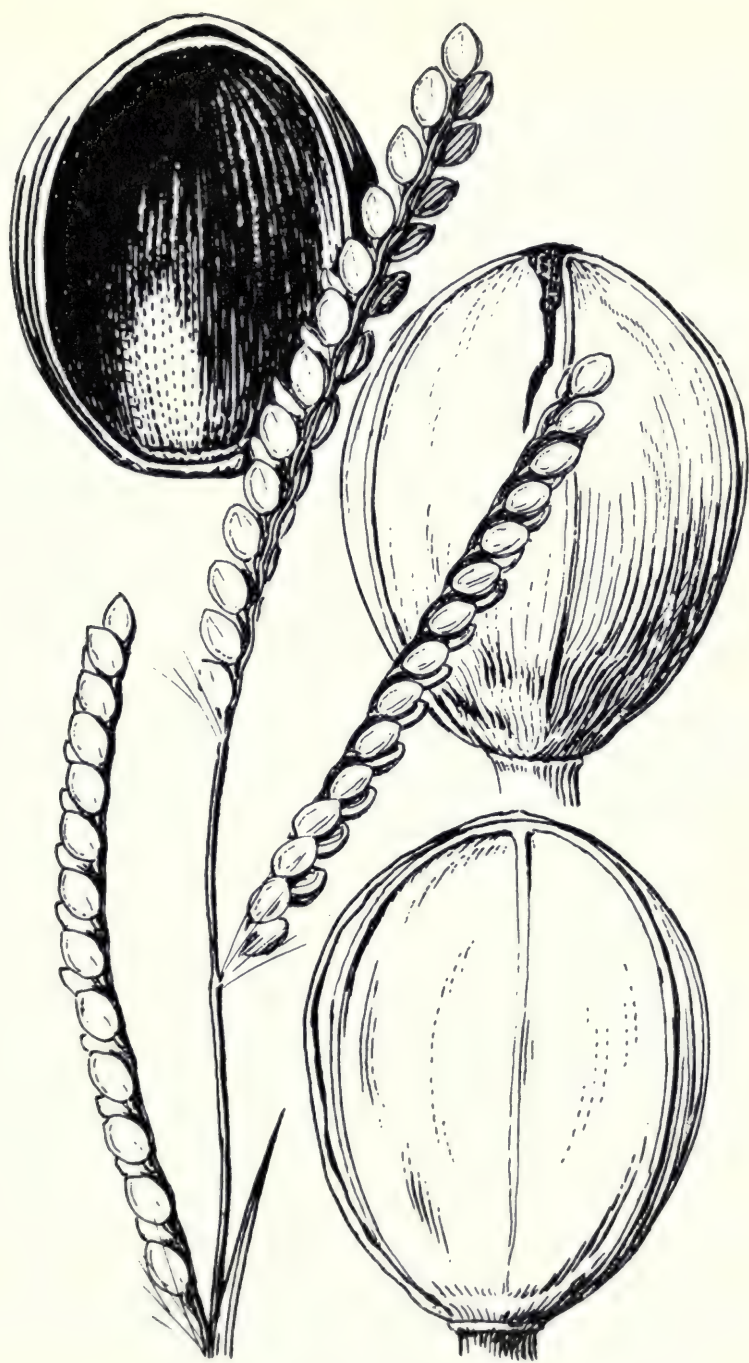


FIG. 148. *Paspalum centrale*. Inflorescence, spikelets.

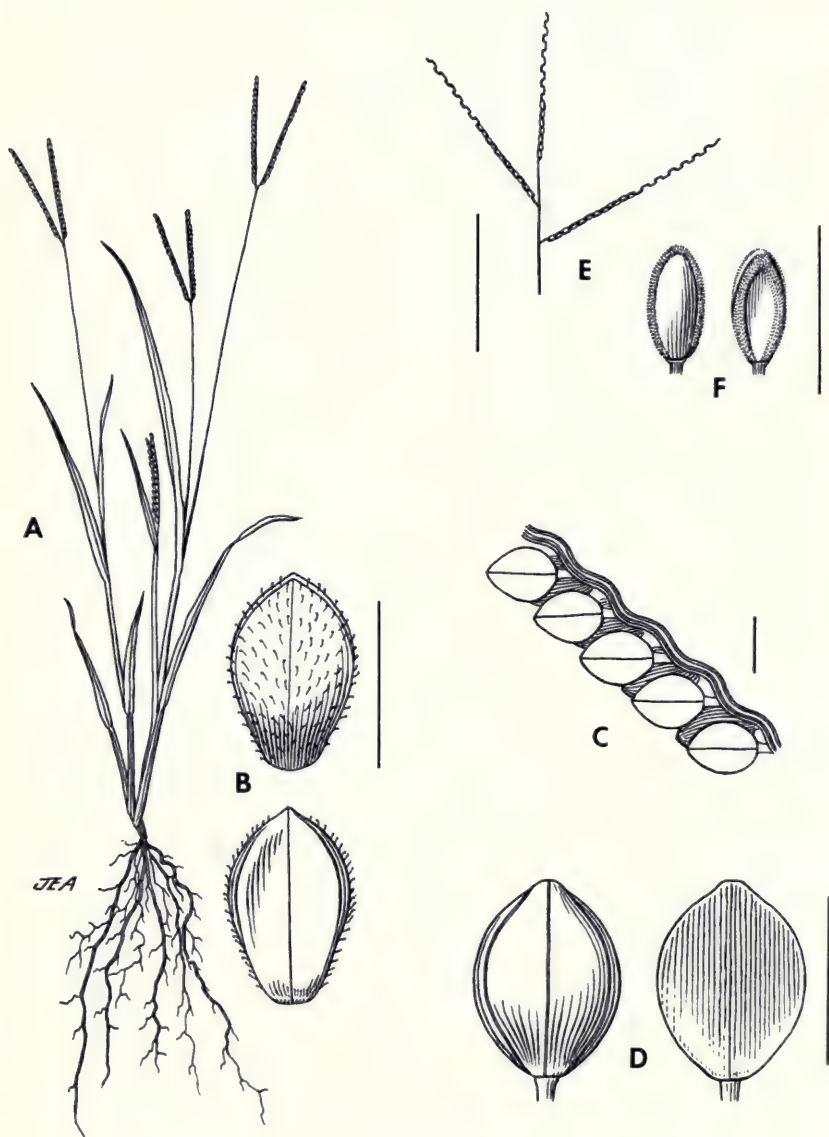


FIG. 149. *Paspalum* species. *P. clavuliferum*: A, blooming plant; B, two views of a spikelet; *P. multicaule*: C, portion of a raceme; D, two views of a spikelet; *P. parviflorum*: E, inflorescence; F, two views of a spikelet.

half of the culms; leaf sheaths more or less papillose-pilose, especially on the margins; ligule a thin, brown membrane, 0.7-1.0 mm. long; leaf blades flat, 3-9 cm. long, 1.5-3.0 mm. wide, the midrib prominent beneath; surfaces papillose-pilose, prominently ciliate; uppermost sheath bearing a reduced or abortive blade. Peduncles terminal and axillary from the upper sheaths, the terminal one very slender, exerted 10-13 cm. beyond the uppermost developed leaf blade, bearing a bladeless sheath; inflorescence a solitary raceme or a conjugate pair at the summit of the peduncle, occasionally a third raceme below them; individual racemes 1-4 cm. long, arcuate, the rachis triquetrous, 0.4-0.5 mm. wide; spikelets paired, 4-rowed, the pedicels less than 0.5 mm. long, puberulent. Spikelets 1.2-1.4 mm. long, obovate 3:2, blunt; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, hyaline, 3-nerved; second glume usually more or less pubescent with minute, capitellate hairs; sterile lemma usually glabrous or with a few capitellate hairs on the margins; both bracts sometimes with minute brownish splotches; rarely the spikelets may be entirely glabrous; upper (fertile) floret about as long as the spikelet, obovate, the lemma and palea stiff, finely striate; anthers 3, tan, 0.2-0.3 mm. long; caryopsis obovate 4:3, blunt, 0.8 mm. long, tan. Chromosome number $n = 10$ from a Costa Rican specimen.

Occasional on dry tuff outcrops, savannas, and sea cliffs, mostly in northern Guanacaste, rare elsewhere. Hacienda Murciélago, Las Animas, Playas del Coco, Piedades de San Ramón. August to December. Southern Mexico to Honduras; Costa Rica to northern South America to Brazil; West Indies.

Plants in the same collection may have densely pubescent or glabrous spikelets. The presence of trapped anthers in spikelets containing mature caryopses suggests that this species is highly cleistogamous, which may account for the presence of glabrous and pubescent strains in close proximity.

***Paspalum conjugatum* Bergius, Acta Helv. Phys.-Math. 7:129. 1762. Figure 150.**

Strongly stoloniferous perennial; flowering culms arising from the rooted stolons, 20-100 cm. long, simple or branching from the lower nodes; internodes 1-3 mm. thick; glabrous, shrunk in drying; nodes mostly glabrous or rarely appressed-bearded; leaf sheaths more or less compressed, usually glabrous except for the finely ciliate overlapping margin; sometimes both margins hyaline and glabrous; ligule a hyaline membrane, 0.3-1.5 mm. long; leaf blades 7-20 cm. long, 7-14 mm. wide, the upper surface sparsely to densely pilose; collar minutely bearded; blades of stolons ovate, blunt, 2-4 cm. long, 5-8 mm. wide. Peduncles terminal on leafy culms, included or exerted up to 7 cm.; inflorescence of 2 conjugate slender divergent or reflexed racemes, rarely a third raceme borne below them on vigorous plants; individual racemes 6-16 cm. long; spikelets solitary, in 2 rows, closely placed; rachis 0.7-0.9 mm. wide, the tip often bearing several minute abortive spikelets; pedicels 0.3-0.4 mm. long. Spikelets strongly flattened, 1.3-1.9 mm. long, elliptic-ovate 1.2-1.4:1, scarcely pointed; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, hyaline, both with 2 marginal nerves, lacking midribs; second glume finely ciliate with hairs up to 1 mm. long; lower lemma similar but not ciliate; upper (fertile) floret ca. as long as the spikelet, whitish,



FIG. 150. *Paspalum conjugatum*. Blooming plant with a stolon, two views of a spikelet, fertile floret.

firm but not rigid, the lemma slightly convex, the palea flat; anthers 3, yellow, sometimes purple-splotted, ca. 0.6 mm. long; styles 2, separate; stigmas dark; caryopsis 1.0-1.1 mm. long, elliptical 1.3:1, tan, the persistent styles reflexed along the sides of the caryopsis. Chromosome number $2n = 40$ from Costa Rican specimens.

A common weed in moist pastures, road ditches, marshes, beaches, cafetales, etc. On both Pacific and Caribbean slopes, from sea level to 1,200 m. elevation. Blooming yearlong. Southern United States to Argentina; naturalized in the tropics of the Old World.

This species is weedy and aggressive in wet pastures. It is almost universally regarded with disfavor and said to be rejected by livestock and to increase under grazing conditions. Common name *Turvurá* or *Turbará*. Our slides showed no pairing in meiosis, and it may be that the species, which is highly uniform in aspect, is completely apomictic. Several minor variants have been described, but my measurements show complete intergradation in spikelet and leaf blade size. Such variation as occurs appears to be related to fertility and moisture supply.

Some authors have ascribed the name of this species to Swartz, on the basis that the original publication by Bergius was a phrase name. However, Bergius gives the name as "*PASPALUM (conjugatum) spicis conjugatis*." His usage differs from that of Linnaeus, who placed the "trivial" name in the page margin, whereas Bergius placed it after the generic name but in parentheses. His intent seems clear, and there is no reason to reject his authorship. The identity of the plate accompanying the description is conclusive.

***Paspalum convexum* Humb. & Bonpl. in Flügge, Monogr. *Paspalum* 175. 1810. Figure 151.**

Caespitose annual, the culms prostrate to ascending, 10-60 cm. long, the plants often mat-forming; culms branching freely from base and lower nodes, the branches sometimes fasciated; culms 1.0-1.5 mm. thick, the internodes usually shrunken in drying, glabrous; nodes glabrous; leaf sheaths loose, keeled, glabrous to densely papillose-pilose; ligule a thin brown membrane, 1-2 mm. long; leaf blades flat, rounded to the base, the midrib prominent beneath, usually 5-18 cm. long, 5-9 mm. wide, from densely papillose-pilose to nearly glabrous; uppermost blade usually very reduced. Peduncles included or exerted up to 7 cm.; inflorescences terminal on the main culm or on leafy branches, 4-8 cm. long, composed of 1-5 solitary racemes borne along a central rachis; individual racemes 3-5 cm. long; rachis ca. 1 mm. wide, with a tuft of long white hairs at its base; spikelets crowded, usually paired on each side of the midrib, in occasional individuals one spikelet of the pair abortive and the raceme thus appearing 2-rowed. Spikelets 1.8-2.5 mm. long, obovate to subcircular 1.3-1.0:1, strongly plano-convex, the depth nearly equal to the width; first glume absent (present in one abnormal individual); second glume nearly as long as the spikelet, 5-7-nerved; lower (sterile) lemma as long as the spikelet, 5-nerved, both bracts very thin and membranaceous, bearing scattered fine appressed



FIG. 151. *Paspalum convexum*. A, blooming plant; B, portion of a raceme; C, two views of a spikelet.

hairs; occasional individuals have a rigid, convex, shiny brown sterile lemma, similar to the fertile lemma; upper (fertile) floret nearly as long as the spikelet, the lemma very strongly convex, shiny, striate, chestnut brown; palea similar, flat; lodicules 2, truncate; anthers 3, purple, 0.8-1.1 mm. long. Chromosome numbers $n = 10, 16, 20, 24$ from Central American and Venezuelan specimens.

This species is a weedy, sprawling annual of disturbed sites, roadsides, ditches, savannas, sea cliffs; common at lower elevations in northwestern Guanacaste and in the lower General Valley; occasional in the western portions of the Meseta Central. Elevations sea level to 600 m., rarely to 1,400 m. Blooming mostly July to January. Northern Mexico to Brazil; West Indies.

This species shows considerable variation in size, pubescence, and inflorescence and spikelet characteristics. It also has meiotic and chromosomal abnormalities. *Paspalum convexum* was assigned to the informal group *Plicatula* by Chase, along with *P. plicatulum* and *P. centrale*.

***Paspalum corypheum* Trin., Gram. Pan. 114. 1826. Figure 152.**

Caespitose perennial from hard knotty crowns; culms 65-400 cm. long, erect or scrambling in brush, branching freely when older; internodes 2-4 mm. thick, hollow, glabrous or appressed-pilose, especially below the nodes; nodes densely bearded with appressed or spreading hairs; leaf sheaths keeled, mostly overlapping, the lower ones pustulose-hispid, the upper ones less pubescent; overlapping margin ciliate; collar conspicuously bearded; ligule a firm brown membrane, 1.0-4.5 mm. long; leaf blades flat, usually 30-50 cm. long, 10-13 mm. wide, tapered to a narrow or cordate base; a dense tuft of long, glassy hairs just behind the ligule, surfaces glabrous or puberulent, midrib conspicuous, white, edges strongly scabrous, sometimes papillose-ciliate; uppermost sheath bladeless or with a short abortive blade. Peduncles terminal on leafy branches,



FIG. 152. *Paspalum corypheum*. Portion of inflorescence, two views of a spikelet, fertile floret.

exserted up to 18 cm.; inflorescence 8-24 cm. long, of 15-44 racemes borne singly or whorled along a scabrous-angled central rachis; individual racemes 5-13 cm. long, the rachis ca. 0.5 mm. wide, bearing a tuft of stiff white elongate hairs at its base, sometimes a few scattered hairs along its length; spikelets paired, in 2 rows on each side of the midrib. Spikelets 2.0-2.5 mm. long, obovate ca. 2:1, acute; first glume absent; second glume nearly as long as the spikelet, 3-nerved, brownish and speckled with fine papillose-based hairs; lower (sterile) lemma similar, 3-nerved, as long as the spikelet, glabrous or sparsely hairy; upper (fertile) lemma nearly as long as the spikelet, whitish, finely striate; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 1.2-1.4 mm. long; styles 2, separate; stigmas deep purple. Chromosome number $n = 30$ from a specimen from Honduras.

Dry, rocky *Curatella-Byrsonima* savannas, from the La Cruz area to Cañas; elevations 75-300 m. July to August. Belize and Honduras; Costa Rica and Panama and northern South America to Brazil; Trinidad.

Our specimens apparently represent this species in an early blooming stage, before branching has occurred. Chase indicates that the plants may become much longer and more branched with age, and that the panicle branches may droop. The spikelets of *P. corypheum* are rather similar to those of *P. botterii*, but lack any evidence of the first glumes present in the latter species.

***Paspalum costaricense* Mez, Fedde, Repert. Sp. Nov. 15:72. 1917. Figure 153.**

Caespitose perennial, the small clumps arising from a knotty crown; culms unbranched, 30-75 cm. tall, 2-3 mm. thick, hollow, glabrous; nodes glabrous; leaf sheaths overlapping, glabrous except for the finely ciliate overlapping margin; ligule a thin brown membrane, 3-5 mm. long; leaf blades thin, flat, lax, ovate-obovate 5-8:1, usually 10-18 cm. long, 15-30 cm. wide, abruptly acuminate; midrib white, prominent; base rounded; margins short-ciliate; surfaces usually glabrous, rarely with a few short hairs near the margins; terminal sheath with a much reduced or abortive blade. Peduncles solitary, terminal on leafy culms, exserted up to 9 cm. from the terminal sheath; inflorescence 6-13 cm. long, an open raceme of 5-7 solitary, ascending racemes borne singly along a flattened rachis; individual racemes 4-7 cm. long, their rachis flattened, 0.6-1.0 mm. wide, with a low midrib; base of each raceme with a tuft of elongate glassy hairs; spikelets paired, in 2 rows on each side of the midrib; pedicel of the terminal spikelet of each pair 1.0-1.5 mm. long, that of the lower spikelet ca. half as long. Spikelets 2.4-2.8 mm. long, elliptical-obovate 1.7-2.0:1, barely acute; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, very finely appressed-pubescent to nearly glabrous, thin, 3-5-nerved, brownish or purple-splotted; upper (fertile) floret elliptic-obovate, 2.2-2.5 mm. long, stramineous, finely striate; lemma convex; palea similar, flat; anthers 3, 0.9-1.0 mm. long, dark; styles 2, separate; stigmas dark; caryopsis elliptic 1.4:1, tan, 1.9 mm. long; embryo large, a brownish stripe at the base of the caryopsis opposite the embryo. Chromosome number $n = 30$ from a Costa Rican specimen.

Moist, partially shaded sites; roadsides, brush, banana fields.



FIG. 153. *Paspalum costaricense*. A, plant base; B, culm and inflorescence; C, two views of a spikelet.

Meseta Central, 1,100-1,700 m. elevation; San José area, Aserrí, Tarabaca, Copey. The type specimen was collected near the San José Railroad Station. Apparently blooming yearlong, but most specimens have been collected from June to August. Guatemala, Honduras, El Salvador, Costa Rica.

The very broad, lax leaf blades of this species are distinctive.

***Paspalum decumbens* Swartz, Prodr. Veg. Ind. Occ. 22. 1788.**

Duration indefinite, probably perennial; plants decumbent, forming mats, rooting from the nodes of prostrate portions; erect leafy branches 15-40 cm. long; prophylla 10-20 mm. long; internodes 1.0-1.5 mm. thick, hollow, glabrous; nodes often ciliate; leaf sheaths keeled, finely ciliate on the overlapping margin, the surface glabrous or softly pilose; ligule a thin brown membrane, 0.3-0.5 mm. long, sometimes forming an auricle; leaf blades ovate 4.5-10:1, acuminate, 3-7 cm. long, 7-12 mm. wide, flat, the midrib prominent beneath; base cordate, contracted into a short pseudopetiole; margins ciliate, surfaces more or less pilose. Peduncles 1-6 from the uppermost sheath, very slender, exerted up to 7 cm., more or less pilose, especially toward the apex; inflorescence a solitary arcuate raceme, 7-30 mm. long; rachis ca. 0.5 mm. wide, its margins slightly raised and incurved, sometimes bearing scattered elongate hairs; pedicels scabrous, the members of each pair equal, forked from the base; spikelets paired, in 4 rows, crowded. Spikelets 1.5-1.7 mm. long, glabrous, broadly obovate 1.2-1.4:1, strongly plano-convex; first glume a broad, truncate nerveless scale, 0.2-0.4 mm. long; second glume broadly ovate, blunt, 1.1-1.2 mm. long, 3- or rarely 5-nerved, the lateral nerves not close to the margins; lower (sterile) lemma as long as the spikelet, 3-nerved, the lateral nerves marginal; lemma enclosing a well-developed, 2-nerved flat palea 1.1-1.4 mm. long; fertile lemma 1.4-1.5 mm. long, the upper half of the back exposed; surface striate, whitish; palea similar, flat; lodicules 2, truncate; anthers 3, 0.6-0.8 mm. long, usually white; styles 2, separate; caryopsis suborbicular, ca. 0.9 mm. long, plano-convex, tan. Chromosome number $n = 10$ from Costa Rican specimens.

Moist forests and forest margins, brush, riverbanks, roadsides and ditches, road embankments; sea level to 1,200 m. elevation; common in moist areas on both Pacific and Caribbean slopes; absent from drier parts of Guanacaste. Blooming yearlong. Guatemala to Brazil and Bolivia; West Indies.

This rather weedy species is highly unusual in its genus by possessing not only first glumes but a well-developed palea in the sterile lemma. This species is most closely related in our flora to *P. nutans*, a tetraploid with longer racemes and larger spikelets.

***Paspalum dilatatum* Poir., Lam. Encycl. 5:35. 1804.**

Caespitose perennial; culms arising from short, densely scaly rhizomes; plants up to 175 cm. tall, the culms ascending and arching, simple or rarely branched from lower nodes; prophylla up to 15 cm. long, prominent; internodes oval, 2-4 mm. thick, hollow, glabrous; nodes swollen, sparsely appressed-pubescent; leaf sheaths longer or shorter than the internodes, loose, keeled, the lowermost ones more or less appressed-pilose with weak hairs; upper sheaths glabrous; margin glabrous; ligule a firm brown mem-

brane, 1-5 mm. long; leaf blades linear, up to 52 cm. long, tapering to a narrow base, up to 10 mm. wide, glabrous except for a few long hairs on the basal margins; midrib keeled below, white; blades flat, folded near the base. Peduncles slender, solitary, exerted up to 30 cm.; inflorescence usually of 3-5 solitary racemes borne racemously along a flattened rachis up to 9 cm. long; individual racemes arcuate, drooping, 3-10 cm. long, with a tuft of long silky hairs at the base; rachis 1.0-1.3 mm. wide; spikelets paired in 2 rows on each side of the low midrib. Spikelets strongly dorsally flattened, ovate 1.5-1.6:1, acute, 3.1-3.7 mm. long; first glume absent; second glume and lower (sterile) lemma herbaceous, 5-7-nerved, both exceeding the upper (fertile) floret and flattened beyond its tip; second glume slightly longer than the sterile lemma, bearing a prominent marginal fringe of soft, fine hairs; sterile lemma similar but with fewer cilia; surfaces of both bracts with scattered fine appressed hairs; upper (fertile) floret broadly ovate 1.2-1.3:1, blunt, the lemma stramineous, finely striate, strongly flattened; palea similar, flat; lodicules 2, truncate; anthers 3, 0.9-1.4 mm. long, deep purple; styles 2, separate; stigmas purple; caryopsis (one seen) 1.3 mm. long, elliptical, tan, with a longitudinal brown mark opposite the embryo. Chromosome number $2n = 50$ determined from Costa Rican collections.

Roadsides, pastures, meadows; occasional on the volcanoes of the Cordillera Central, 1,900-2,600 m. elevation; Vara Blanca, Volcán Poás, Volcán Turrialba. Native to southern South America and probably introduced to Costa Rica as a forage plant; now widely distributed as a wild and cultivated plant in the southern United States and in many other warm temperate and tropical parts of the world. Meiosis in our plants was irregular and the plants are apomictic.

***Paspalum distichum* L.**, Syst. Nat. ed. 10, 2:855. 1759. *P. paspaloides* (Michx.) Scribn., Mem. Torrey Bot. Club 5:29. 1894. Figure 154.

Extensively rhizomatous and stoloniferous perennial; erect portions of the culms 12-30 cm. long, simple; internodes up to 2 mm. thick, solid, glabrous; nodes appressed-pubescent, somewhat swollen; leaf sheaths loose, keeled, glabrous to papillose-pilose, especially at the nodes, throat, and collar; ligule a thin brown truncate membrane, 0.4-1.5 mm. long; leaf blades 2.5-10.0 cm. long, 3-6 mm. wide, usually glabrous except for the papillose-ciliate lower margins, rarely finely pilose above, often folded. Peduncles included or exerted up to 4 cm.; inflorescences terminal on the ascending or erect culms, consisting usually of 2 racemes, the lower one sessile or subsessile, the upper one borne on a rachis 5-10 mm. long; sometimes a third raceme borne below the terminal pair; individual racemes 1-6 cm. long, the flattened rachis 1-2 mm. wide, with a prominent midrib; a solitary spikelet borne at the tip of the rachis; spikelets solitary, in 2 rows. Spikelets very short-pedicellate, 2.7-3.2 mm. long, obovate 1.9-2.4:1, strongly dorsally flattened; first glume absent or, if present, deltoid to linear, 1-nerved, up to 1.9 mm. long, highly variable in one inflorescence; second glume and lower (sterile) lemma equal, as long as the spikelet, 3-5-nerved; glume glabrous, the lemma appressed-pubescent with fine hairs; sterile lemma enclosing a rudimentary, usually bifurcate, membranaceous palea, up to 1 mm. long; upper (fertile) floret ca. 2.7 mm. long, the lemma flattened, whitish, finely striate, firm but not rigid; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 1.3-1.5 mm. long; styles 2, separate; stigmas deep purple. Chromosome number $n = 30$ from Costa Rican specimens.

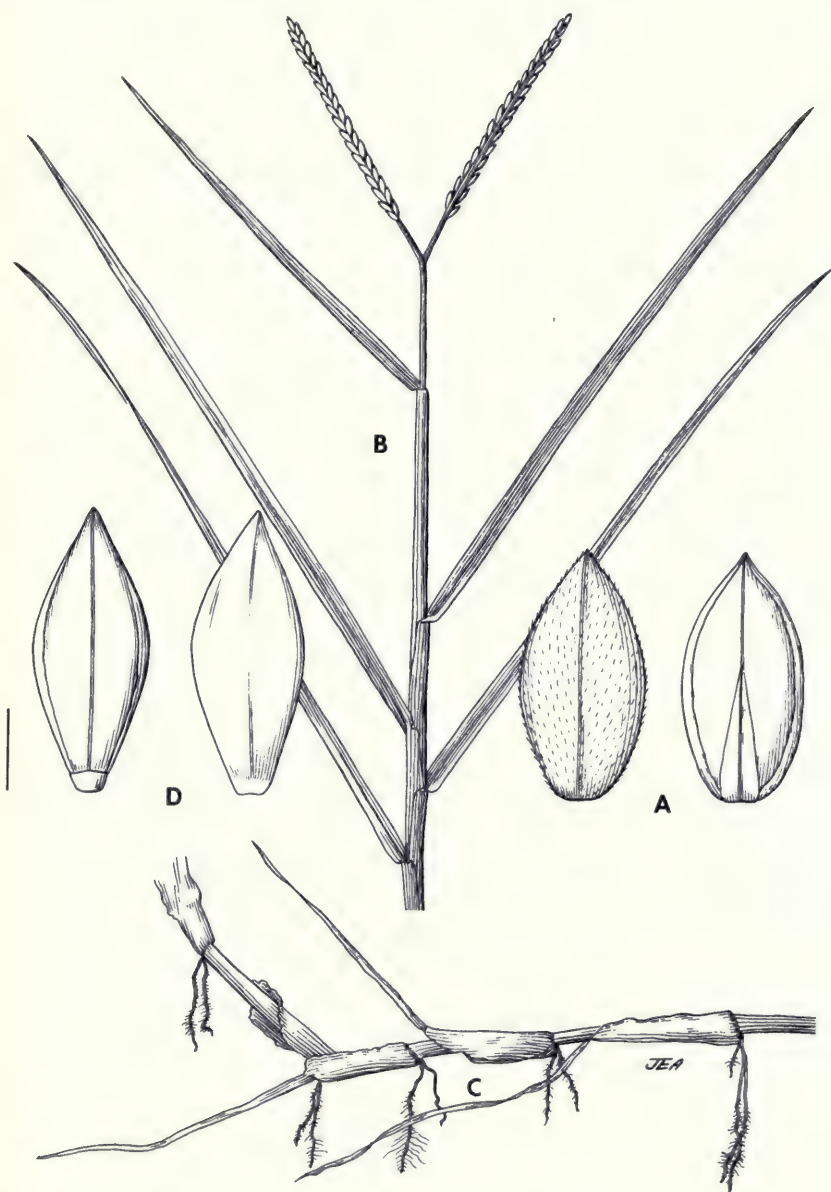


FIG. 154. *Paspalum* species. *P. distichum*: A, two views of a spikelet; *P. vaginatum*: B, blooming culm; C, rhizomatous base; D, two views of a spikelet.

Occasional, wet roadside ditches, wet pastures, margins of irrigation ditches; mostly at intermediate elevations in the interior, from 1,000-1,500 m. elevation. Monteverde, Birrí, Meseta Central, Cartago, Juan Viñas, Liverpool. June to November. Southern United States, northward to New Jersey and Washington near the coasts, southward to Argentina and Chile; West Indies; Eastern Hemisphere in warm areas.

This species is confined mostly to the interior of Costa Rica, whereas the very similar *P. vaginatum* occurs only on the coasts. Tetraploids ($n = 20$) have been reported from other regions. Recent nomenclatural arguments as to the identity of the Linnean type material have been advanced by Fosberg (*Rhodora* 78:84. 1976) and Gúedès (*Taxon* 25:512-513. 1976), who come to contradictory conclusions as to the name of this taxon. I have followed Gúedès, who uses the name in the traditional sense.

***Paspalum fasciculatum* Willd. in Flügge, Monogr. *Paspalum* 69. 1810. Figure 155.**

Tall, coarse stoloniferous perennial, forming dense colonies; bases trailing and rooting up to 5 m.; erect culms simple or sparingly branched, to 3 m. tall; internodes glabrous, 3-7 mm. thick, solid; nodes swollen, the sheath base covering the node glabrous to copiously bearded; leaf sheaths shorter or longer than the internodes, glabrous or



FIG. 155. *Paspalum fasciculatum*. Inflorescence, two views of a spikelet, fertile floret.

pustulose-hispid, especially near the base and apex; overlapping margin long-ciliate with fine hairs; ligule a firm brown membrane, 0.3-0.7 mm. long, a row of stiff white hairs, 3-4 mm. long behind it; leaf blades flat, keeled beneath, 20-70 cm. long, 10-20 mm. wide; surfaces glabrous to sparsely pilose, often with elongate hairs on the throat, collar, and behind the ligule. Peduncles solitary, terminal on leafy culms; exserted up to 6 cm. from the nearly bladeless uppermost sheath; inflorescence 8-18 cm. long, 7-15 cm. wide, a rather dense fan-shaped panicle of 8-33 racemes borne racemosely along a short, angled rachis 5-11 cm. long; racemes crowded, ascending or later drooping, 7-16 cm. long, the lower ones longer than the upper; base of each raceme bearing a tuft of stiff white elongate hairs; rachis flat, 0.8-1.4 mm. wide, with a low midrib; spikelets solitary, the raceme 2-rowed. Spikelets 3.7-4.6 mm. long, ovate 2.3-2.7:1, acuminate, strongly dorsally flattened; first glume a minute nerveless scale or commonly absent; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 3-5-nerved, the margins bearing a fringe of fine silky hairs; sterile lemma similar, 3-7-nerved, the margins very sparsely ciliate; upper (fertile) floret 3.3-4.3 mm. long, ovate 2.4-3.1:1, acuminate, strongly dorsally flattened, the lemma finely striate; palea similar, flat; lodicules 2, truncate; anthers 3, orange, 2.2-2.8 mm. long; styles 2, separate; stigmas deep purple; caryopsis elliptical 2:1, brownish, with a dark line two-thirds as long arising from the base opposite the embryo. Chromosome number $n = 10$ from Costa Rican specimens.

Roadsides, marshes, open weedy sites, pastures, mostly in moist areas; sea level to 600 m. elevation, rarely higher; near the Pacific and Caribbean Coasts; San José area; Turrialba; Laguna de Arenal. Blooming July to November. Southern Mexico to Argentina and Ecuador. Common name: *Gamalote*.

***Paspalum humboldtianum* Flüggé, Monogr. *Paspalum* 67. 1810. Figure 156.**

Rhizomatous perennial, forming tufts; culms 59-120 cm. long, erect to decumbent; rhizomes abundant, scaly; culms branching mostly from the lower nodes; internodes glabrous, hollow, 1.5-2.0 mm. thick; nodes not prominent, glabrous or appressed-bearded; lower leaf sheaths overlapping, the upper shorter than the internodes; foliage aggregated on the lower parts of the plants; overlapping margin of the sheaths ciliate, the surfaces from nearly glabrous to papillose-hirsute or hispid, especially toward the apex; ligule a thin brown membrane, 1.8-3.8 mm. long; leaf blades 7-14 cm. long, 8-17 mm. wide, flat, more or less appressed-pilose to nearly glabrous; sometimes papillose-ciliate with long hairs; base of blade broad, subcordate; tip acuminate; uppermost leaf blade much reduced. Inflorescences terminal on leafy culms; peduncle exserted 6-12 cm.; panicle 5-11 cm. long, composed of 1-5 ascending racemes borne on a common rachis up to 7 cm. long; rachis of individual racemes 4-7.5 cm. long, the rachis 1.0-1.5 mm. wide, with a wide white midrib and flattened green margins; tip naked or bearing abortive spikelets; spikelets overlapping, in 2 or 4 rows in the same raceme, one of each pair longer-pedicellate than the other. Spikelets dorsally flattened, 3.0-3.7 mm. long, ovate 2.3-2.4:1, acute, prominently white-ciliate; first glume absent; second glume as long as the spikelet, 3-nerved, the lateral nerves marginal, thickened, bearing a dense row of radiating, pustulose-based white cilia 2-3 mm. long; surface glabrous or sometimes puberulent; lower (sterile) lemma 3.0-3.5 mm. long, 3-nerved, narrower than the glume, ovate 3:1, glabrous or scabrid toward the tip; upper (fertile) lemma 2.3-2.7 mm. long, elliptic-obovate 2.3:1, whitish, smooth and shining, firm, not rigid; palea similar and of

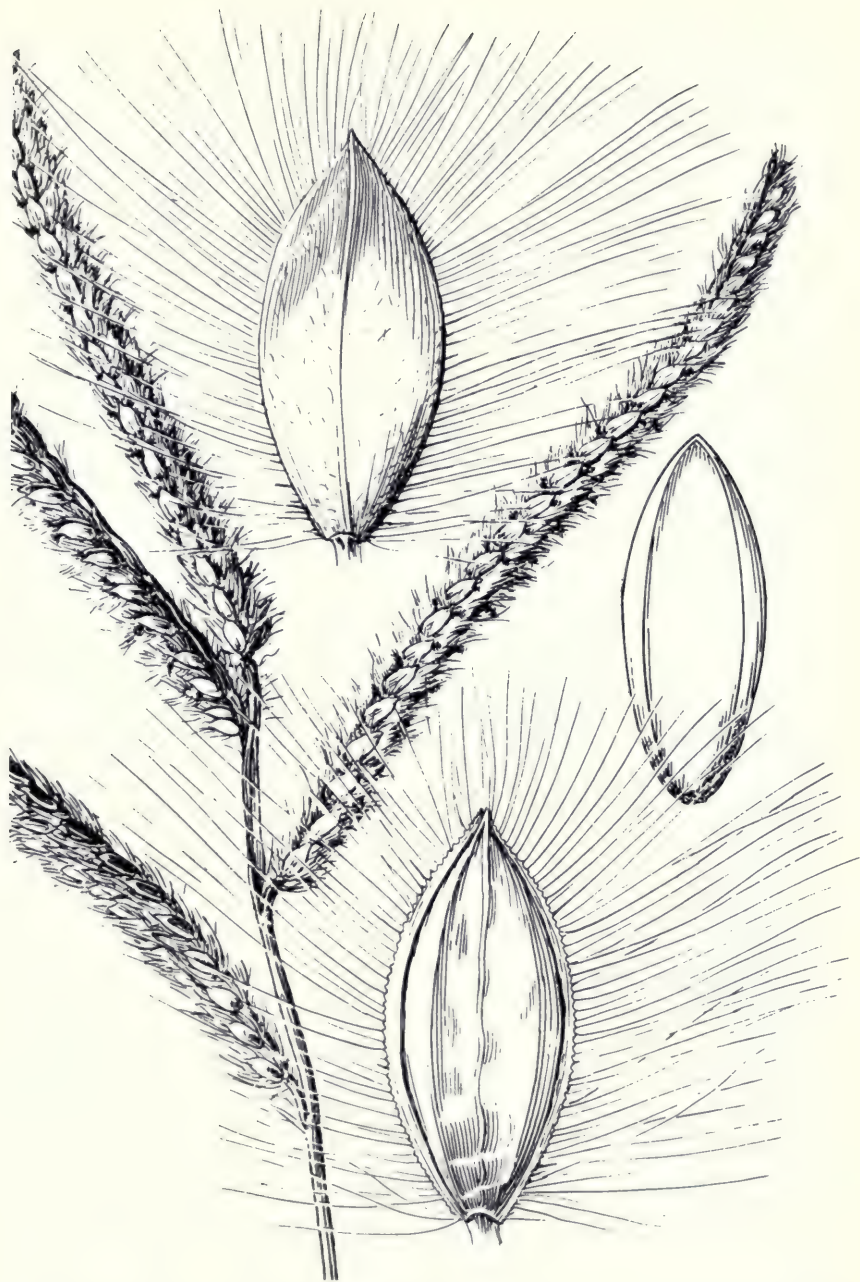


FIG. 156. *Paspalum humboldtianum*. Inflorescence, two views of a spikelet, fertile floret.

equal length; lodicules 2, truncate; anthers 3, purple, 1.5-2.2 mm. long; styles 2, separate; stigmas purple.

Rare or overlooked; dry tuff savannas, steep dry road embankments. Liberia, Nuestro Amo, San Rafael de Cartago, San Juan Norte, Catarata Los Novios, Boruca savannas. August to November. Mexico to Argentina.

Paspalum humboldtianum was included in the subgenus *Ceresia* by Chase, along with *P. pectinatum* and *P. stellatum* in our flora. It differs from the other species in its much narrower rachis. Chase states that the rachis is 2-3 mm. wide, but our material never has a rachis wider than 1.5 mm.

Paspalum jimenezii Chase, Contr. U.S. Natl. Herb. 28:159. 1929. Figure 157.

Rhizomatous perennial; rhizomes extensive, mostly buried in mud; ascending portions of the culms up to 20 cm. long, simple; branching abundant from the rhizomes; internodes up to 1 mm. thick, hollow, glabrous; nodes appressed-pilose; leaf sheaths keeled, glabrous; overlapping margins of sheaths finely ciliate; ligule a thin membrane, 0.2-0.3 mm. long; leaf blades flat, mostly 4.5-8 cm. long, 4-6 mm. wide, glabrous, the midrib prominent beneath, the tip acute, collar pilose-bearded. Peduncle included in the uppermost sheath; inflorescences terminal on leafy culms, 2.5-3.0 cm. long, of 3-8 diverging racemes borne on a short common rachis; individual racemes 2.0-2.5 cm. long; rachis 0.5 mm. wide, flat; pedicels 0.3-0.4 mm. long; spikelets borne in 2 rows. Spikelets 1.4-1.5 mm. long, ovate 5:3, acute; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, glabrous, hyaline, each with 2 marginal nerves, the midribs absent; upper (fertile) floret as long as the spikelet, the lemma faintly striate, stiff but not rigid; palea equal, flat; anthers 3, pinkish, 0.6 mm. long; styles 2, separate; stigmas purple.

Paspalum jimenezii is a sterile clone, reproducing only by rhizomes. It occurs on the muddy banks of the tidal Río Bebedero, at a locality known as Las Playitas, on Hacienda Taboga, southwest of Cañas. It was first collected at this locality in 1913 by Jiménez, and we found it there again in 1969. At that time, it formed a sizable population on the banks of the river. Chromosome counts made from cytological fixations showed that the chromosome number is $2n = 30$, and that meiosis is highly irregular. No viable pollen is formed, and both our collections and the type specimen show collapsed, empty, and shrunken pollen grains. No other specimens of *P. jimenezii* than the two cited below are known. A third specimen from Panama in US, so named by Chase, has normal fertile pollen and is probably of different origin. It is probable that *P. jimenezii* is the result of a cross between the similar *P. standleyi* ($n = 20$) and a diploid species, possibly *P. orbiculatum*. I revisited the type locality in 1976, but was unable to find the original colony. Extensive pasture improvement had been carried out at the

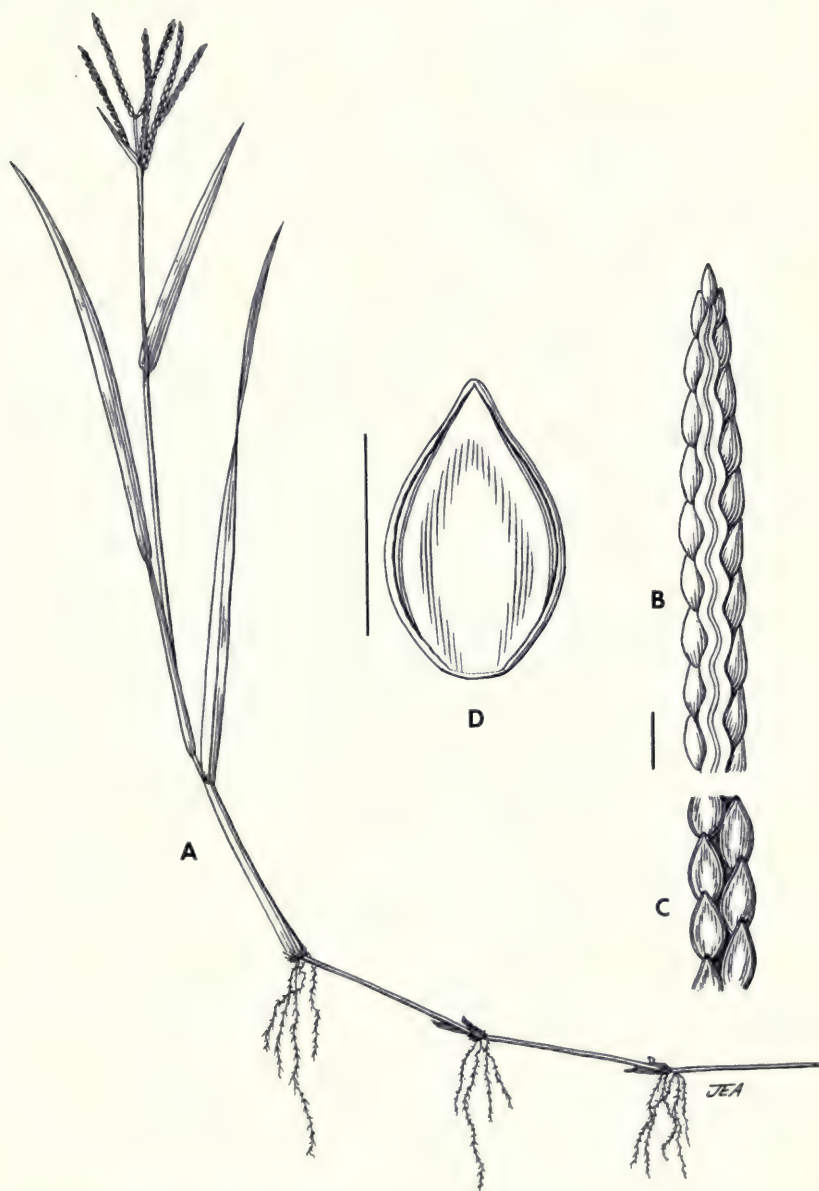


FIG. 157. *Paspalum jimenezii*. A, blooming plant with rhizomatous base; B, raceme from rachis side; C, raceme from spikelet side; D, spikelet.

site, and it is possible that the clone had been destroyed. Its long persistence at this site probably occurred because the plants were able to cope with tidal mud deposition by their extensive production of rhizomes. A further account of the cytology is in Pohl & Davidse (1971).

Guanacaste: Las Playitas del Río Bebedero, Hda. Taboga, 5 January 1913, *O. Jiménez 742* (holotype in US, duplicate in CR); same location: 16 January 1969, *Pohl & Davidse 11660*. Jiménez stated that Las Playitas was at an altitude of 50 m. This is certainly an error, as the Río Bebedero is tidal at that point.

***Paspalum lineare* Trin., Gram. Pan. 99. 1826.**

Densely caespitose perennial in small hard clumps; bases of the culms covered with old sheaths (basal foliage often burned off); culms slender, seldom branched, 1.0-1.5 mm. thick, hollow, glabrous, 40-110 cm. tall; nodes densely upwardly bearded with appressed white hairs; leaf sheaths pilose to glabrous, with a few elongate hairs around the throat; basal leaf blades up to 60 cm. long, the culm blades much shorter, the uppermost one much reduced; ligule a short firm membrane, 0.4-1.0 mm. long, decurrent on the sheath margins; auricular hairs long, conspicuous, papillose-based; leaf blades 1.0-1.5 mm. wide, laterally flattened, the upper surface reduced to a minute groove by the union of the left and right sides of the blade. Peduncle exerted 10-15 cm., glabrous except for the bearded apex; racemes usually 2, 4-6 cm. long, ascending, the lower one sessile, the upper one a rachis 4-10 mm. long; a tuft of long, silky hairs at the base of each raceme; rachis of the racemes zigzag, 0.4-0.7 mm. wide, the basal 4-6 mm. naked; spikelets few, rather distant, solitary in 2 rows; pedicels up to 2 mm. long. Spikelets 4.3-5.0 mm. long, narrowly elliptical 2.6-2.9:1, acute; first glume absent; second glume and lower (sterile) lemma equal, 5-nerved, firm, glabrous except for 2 tufts of minute hairs on the basal margins of the glume; upper (fertile) floret rigid, stramineous, papillose-striate, 3.8-4.3 mm. long, elliptical 2.7-2.9:1, acute; palea similar, slightly concave; lodicules 2, truncate; anthers not seen; styles 2, separate; stigmas purple; caryopsis elliptical 2.0-2.4:1, ca. 2.6 mm. long, tan, with a red line half its length opposite the embryo.

Rare, dry savannas. Two old specimens are known from Costa Rica. They are: Savanes de Cabagra, March 1892, *Tonduz 6548*; Savanes de? Tigre?, *Tonduz 6544*. Southern Mexico (Chiapas) and Belize to Argentina; Cuba.

***Paspalum microstachyum* Presl, Rel. Haenk. 1:215. 1830. Figure 158.**

Duration indefinite, said to be annual; plants caespitose, but the bases of the culms sometimes decumbent and rooting; culms 15-85 cm. long, branching from the base and lower nodes; prophylla 2-6 cm. long; internodes 1-2.5 mm. thick, hollow, glabrous, green or purple; nodes glabrous, dark, not prominent; leaf sheaths longer or shorter than the internodes, glabrous to papillose-pilose; ligule a thin brown membrane, 0.5 mm. long, sometimes with longer hairs behind it; leaf blades flat, ovate 5-10:1, acuminate, 4-23 cm. long, 6-23 mm. wide, more or less papillose-pilose on the upper or both surfaces; bases of upper and middle blades strongly cordate; lower blades tapering to a narrow base.



FIG. 158. *Paspalum microstachyum*. Inflorescence, two views of a spikelet, fertile floret.

Inflorescences mostly terminal, sometimes a smaller secondary one axillary from the uppermost sheath; panicle elongated, 8-14 cm. long, slender, of up to 30 solitary, paired, or whorled spreading or drooping racemes borne along a slender angled rachis; individual racemes 5-30 mm. long; central rachis and those of the racemes bearing scattered elongate weak hairs, to 4 mm. long; pulvini with tufts of hairs; rachis of racemes flat, 0.6-0.8 mm. wide, bearing paired spikelets in 2 rows on each side of the midrib; pedicels slender, the longer one of each pair 1.5-2.0 mm. long, the shorter about a third as long. Spikelets 1.4-1.6 mm. long, elliptical-obovate 1.5-1.6:1, finely puberulent, the bracts whitish or rusty-spotted, hyaline; first glume absent; second glume slightly shorter than the spikelets, 3- or rarely 5-nerved; lower (sterile) lemma as long as the spikelet, 3-nerved; upper (fertile) floret elliptic-obovate, whitish, striate, 1.4 mm. long; lemma rather strongly convex; palea similar, flat; anthers 3, purple, 0.4 mm. long; caryopsis elliptical 1.4:1, opalescent, ca. 1.0 mm. long. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Occasional, roadsides, cut-over rain forests, mostly at elevations below 100 m.; northern Guanacaste to Puntarenas; Río La Vieja, Puerto Viejo, Hacienda de Zent, Atenas, Matina. Guatemala to Peru and Brazil.

This rather weedy species appears to have no close relatives in our flora.

Paspalum minus Fourn., Mex. Pl. 2:6. 1881. Figure 159.

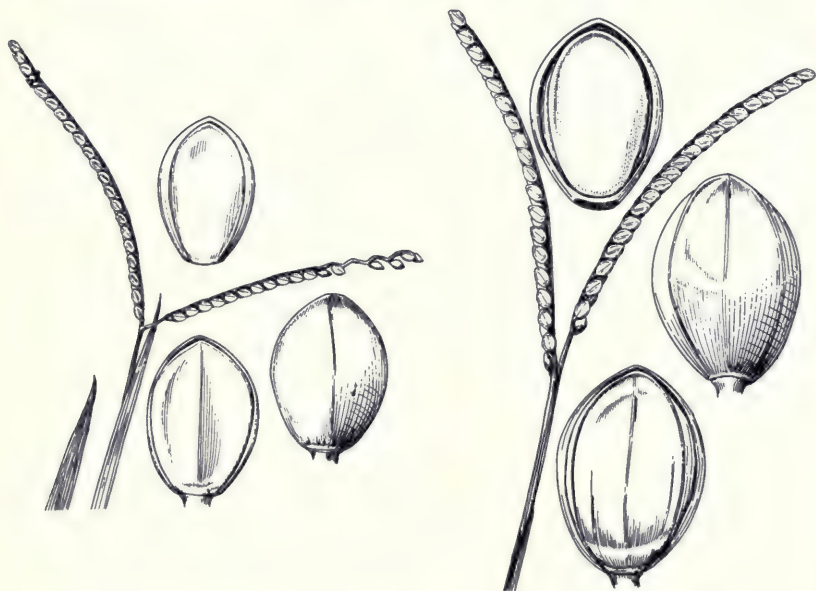


FIG. 159. *Paspalum* species. *P. minus* (left): inflorescence, two views of a spikelet, fertile floret; *P. notatum* (right): inflorescence, two views of a spikelet, fertile floret.

Rhizomatous perennial, forming flat mats; rhizomes thick, woody, scaly; culms unbranched, 27-53 cm. long, mostly lying on the ground; internodes 1-2 mm. thick, glabrous, often collapsed in dry specimens and possibly solid; nodes dark, shrunken, glabrous; foliage yellowish green; leaf sheaths keeled, the lower ones longer than the internodes, the foliage aggregated near the base; upper sheaths shorter than the internodes; sheaths glabrous except for papillose-based cilia on the overlapping margin, especially near the apex; ligule a thin brownish membrane, 0.2-0.7 mm. long, backed by a dense row of stiff erect hairs ca. twice as long; dewlap conspicuous, yellowish; leaf blades as wide as the sheath apex, the lower ones 8-14 cm. long, 4-7 mm. wide, the midrib conspicuous beneath; blade folded near the base; lower margins and occasionally the upper surface bearing scattered elongate pustulose-based hairs up to 8 mm. long; tip abrupt. Peduncles included in the uppermost bladeless sheath or exerted up to 3 cm.; inflorescences terminal on the culms, solitary, consisting usually of a pair of conjugate equal racemes, rarely a third one a short distance below; a pair of stiff deltoid bracts and a tuft of silky hairs borne at the apex of the peduncle between the racemes; individual racemes 4-7 cm. long; rachis 0.8-1.0 mm. wide, zigzag, usually bearing a solitary spikelet at its tip; pedicels ca. 0.5 mm. long. Spikelets solitary in 2 rows, 2.4-2.5 mm. long, ovate-obovate, blunt-pointed, glabrous, green; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 3- or rarely 5-nerved; sterile lemma usually 3-nerved; nerves marginal; upper (fertile) floret 2.1-2.2 mm. long, elliptical or obovate, whitish, striate; lemma more convex than in *P. notatum*; palea similar, flat; anthers 3, purple, 0.9-1.2 mm. long; caryopsis 1.4 mm. long, elliptical 1.4:1, tan; styles reflexed along the upper edges of the caryopsis.

Open, often disturbed areas; savannas, roadsides, pastures; grassy sea beaches; sea level to 750 m. elevation, rarely higher. Common in Guanacaste, scattered elsewhere; San José, Turrialba, General Valley, Puntarenas, Golfito, Barro de Colorado, Tortugero. June to January. Southern Mexico to Peru and Paraguay; West Indies.

The plants may be often overlooked because of their mat-forming habit. Our single chromosome count from Costa Rica (*Pohl 12954*) is $n = 25$, an anomaly in a genus with a basic number of $x = 10$. Previous counts for this species indicated $n = 10$ or 20. *Paspalum minus* is very similar in spikelets and inflorescence to *P. notatum*, differing in spikelet size and growth habit. *Paspalum pumilum* is also similar, but has yet smaller spikelets and lacks the woody rhizomes common to both of the above species.

***Paspalum multicaule* Poir., in Lam. Encycl. Suppl. 4:309. 1816. Figure 149.**

Caespitose annual in small tufts; plants (5) 12-40 cm. tall; culms branching from the base or lower nodes; internodes glabrous, ca. 1 mm. thick, hollow, thick-walled; prophylla up to 2 cm. long; nodes glabrous; foliage mostly on the lower half of the culms; sheaths keeled, nearly glabrous to papillose-hispid, the margins softly ciliate; ligule a thin brown membrane, 0.3-0.5 mm. long; leaf blades mostly 4-12 cm. long, 1.5-2.5 mm. wide, conspicuously papillose-hispid on both surfaces with hairs up to 5 mm. long; sur-

face finely puberulent between the long hairs; midrib prominent beneath; margins of blades becoming revolute; uppermost leaf sheath bladeless. Inflorescences terminal on the main culm or on leafy branches; peduncle included or exerted from the bladeless sheath up to 5 cm.; inflorescence usually a conjugate pair of spreading racemes, these 1-4 cm. long; rarely a third raceme is borne just below the pair; a pair of minute bracts occur at the apex of the peduncle between the racemes; rachis of racemes silky at the base, flattened, with a medial ridge, often zigzag, 0.5-0.7 mm. wide; spikelets in 2 rows; pedicels less than 0.5 mm. long. Spikelets yellowish, nearly circular, 1.1-1.5 mm. long, strongly plano-convex; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 2- or rarely 3-nerved, hyaline, sparsely to densely covered with globular hairs; lower (sterile) lemma 2-nerved, glabrous or with a few marginal globular hairs; upper (fertile) floret about as long as the thin outer bracts; lemma firm, finely striate, its margins sharply inflexed and forming a conspicuous rim around the palea; anthers 3, purple, 0.3 mm. long; styles 2, separate, stigmas emerging laterally from the spikelet; apex of the ovary and the mature caryopsis with a purple splotch; caryopsis nearly circular, 0.8-1.0 mm. long, strongly plano-convex, whitish. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Dry rocky savannas, tuff outcrops; northern Guanacaste; Rincón de la Vieja, Hacienda Murciélago, Liberia, Las Ánimas; Buenos Aires, Boruca; Hacienda Argentina; 200-750 m. elevation. October to February. Southern Mexico; Honduras; Costa Rica to northern South America, Peru, Bolivia, and Brazil; West Indies.

This is one of a group of small annual species including *P. clavuliferum*, *P. pictum*, and *P. parviflorum*.

***Paspalum notatum* Flüge, Monogr. *Paspalum* 106. 1810. Figure 159.**

Rhizomatous perennial, the rhizomes thick and woody, the short internodes densely clothed with stramineous scales; culms simple, erect, 30-70 cm. tall; internodes 1-2 mm. thick, hollow but often collapsed in drying, glabrous; nodes dark, contracted, glabrous; foliage mostly near the bases of the culms, the upper portions with much reduced leaf blades, the ultimate sheath usually bladeless; sheaths keeled, overlapping, glabrous or bearing long, papillose-based cilia on the overlapping margin near the apex; dewlap mostly yellowish, conspicuous; ligule a short membrane, 0.2-0.4 mm. long, a row of stiff hairs just behind it are ca. twice as long; base of blade as wide as the sheath apex, somewhat folded; lower leaf margins bearing papillose-based cilia to 4 mm. long; upper surface of blades sometimes with a few elongate papillose hairs; lower blades 6-24 cm. long, 6-10 mm. wide. Peduncles included or exerted 1.5-4.5 cm., bearing a tuft of glassy hairs at the apex between the racemes; inflorescences terminal, solitary, usually composed of a nearly conjugate pair of equal, diverging racemes, rarely a third present; racemes 3-10 cm. long, naked for a short distance at the base, stiff; rachis flattened, zigzag, 0.7-0.9 mm. wide; spikelets solitary, in 2 rows, closely placed; apex of rachis often bearing a few reduced abortive spikelets. Spikelets greenish, shiny, 3.5-3.8 mm. long, broadly ovate 1.4:1, barely pointed; first glume absent (a few spikelets bearing oblong first glumes 2.5-3.0 mm. long on one specimen); second glume and lower (sterile) lemma equal, as long as the spikelet, glabrous, 5-nerved, the lateral nerves paired near the

margins; upper (fertile) floret 2.8-3.3 mm. long, ovate 1.3-1.4:1, whitish, striate; margins of lemma sharply infolded, forming a flat rim around the equal palea; lodicules 2, truncate; anthers 3, purple, 1.8-2.0 mm. long; styles 2, separate; stigmas purple, laterally exerted; style branches finally reflexed along the upper edges of the caryopsis; caryopsis elliptical 4:3, tan, ca. 2 mm. long; an oblong brown mark present at the base opposite the embryo. Chromosome number $n = 20$ from a Costa Rican specimen.

Open disturbed areas, roadsides, pastures, beaches; sea level to 1,500 m. elevation; occasional in Guanacaste and the Meseta Central; Zarcero, Cartago, Limón. June to October. Eastern Mexico to Argentina; West Indies; widely cultivated in Florida and in other warm climates of the World.

Despite its apparent toughness, this species is cultivated as a forage grass. Common name Jengibrillo. A cultivated type with diploid ($n = 10$) chromosome number is known as *P. sauræ* (Par.) Parodi and probably does not occur in Costa Rica.

***Paspalum nutans* Lam., Tabl. Encycl. 1:175. 1791. Figure 160.**

Duration indefinite, probably perennial; plants decumbent and mat-forming, the culms rooting at the nodes, branching freely from the rooted nodes, the erect culms simple or branched near the base, 25-55 cm. tall; internodes 1-2 mm. thick, hollow, glabrous; nodes glabrous; leaf sheaths usually shorter than the internodes, glabrous except for the densely ciliate overlapping margins; basal sheaths appressed-pilose; ligule a thin brown membrane, 1.2-2.0 mm. long; leaf blades flat, ovate, acuminate, 9-13 cm. long, 7-14 mm. wide, tapering to narrow base; more or less appressed-pilose above and below; midrib white, carinate below; margins not ciliate. Peduncles 1-3 from the terminal sheath, exerted up to 12 cm., glabrous; raceme solitary, arcuate, 3-5 cm. long, with a few elongate hairs at its base; rachis ca. 0.5 mm. wide, its edges incurved; pedicels paired, about equal. Spikelets mostly paired, in 2 rows on each side of the midrib of the rachis, sometimes one of the pair abortive; spikelets 1.7-2.0 (2.2) mm. long, obovate 1.3-1.5:1, blunt, strongly plano-convex; first glume usually absent, or if present, a minute ridge or nerveless scale, up to 0.4 mm. long; second glume shorter than the spikelet, 1.6-2.0 mm. long, 5-nerved, sometimes with a few short hairs on the margins; lower (sterile) lemma as long as the spikelet, 5-nerved, glabrous, occasionally with a hyaline palea to 1.8 mm. long; upper (fertile) lemma 1.8-2.0 mm. long, obovate-elliptical 1.3-1.4:1, whitish, striate, blunt, strongly convex; palea similar, flat; lodicules 2, truncate; anthers 3, white or purple-spotted, 0.7 mm. long; styles 2, separate; caryopsis 1.2-1.4 mm. long, broadly elliptical 1.2-1.4:1, opalescent; a brown spot near the base opposite the embryo. Chromosome number $n = 20$ from Costa Rican and Venezuelan specimens.

Moist forests, along trails or roadsides; elevations 450-1,200 m.; occasional; Barbacoas, Rivas, La Hondura, Cañas Gordas, Aguas Zarcas. January to October; probably blooming yearlong. Guatemala and Belize to northern South America and Brazil; West Indies.

This species is most closely related to *P. decumbens*, from which it differs in larger spikelet size and in chromosome number.

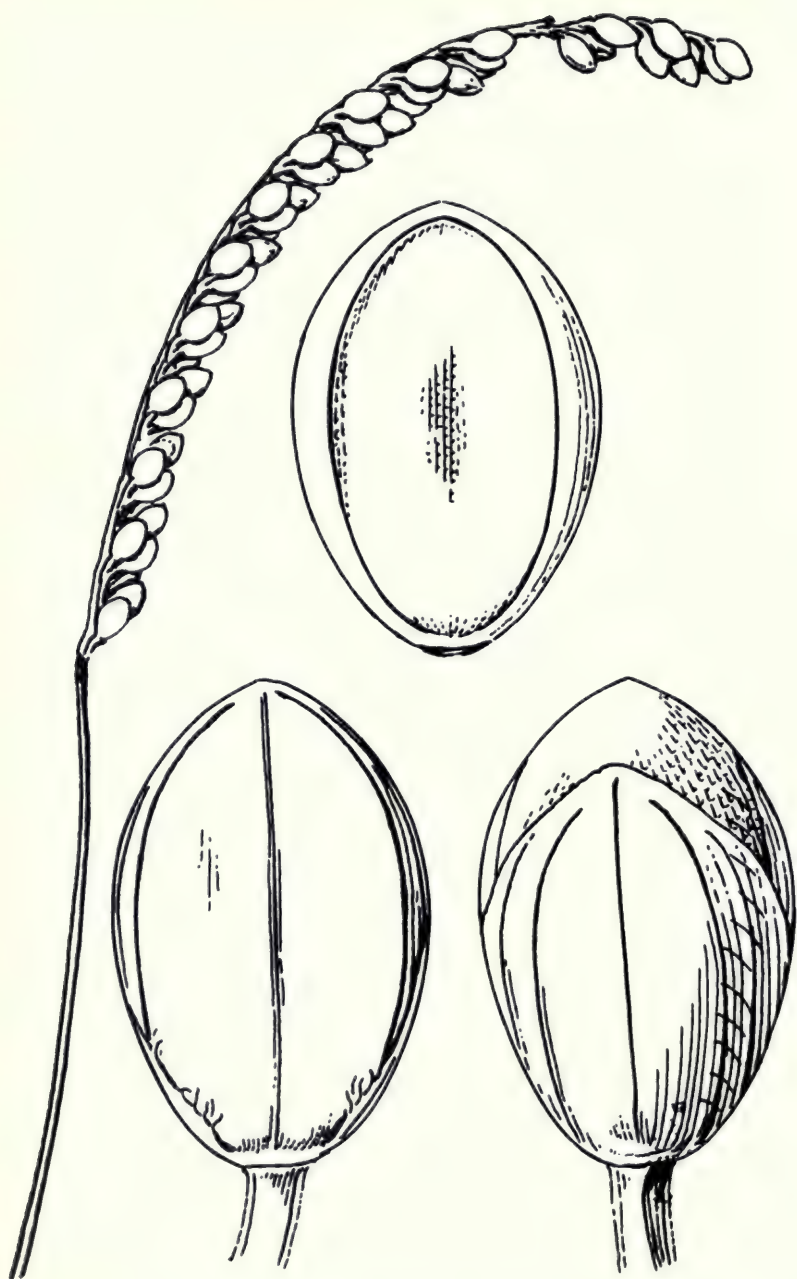


FIG. 160. *Paspalum nutans*. Inflorescence, two views of a spikelet, fertile floret.



FIG. 161. *Paspalum orbiculatum*. Inflorescence, two views of a spikelet, fertile floret.

***Paspalum orbiculatum* Poir., Lam. Encycl. 5:32. 1804. Figure 161.**

Duration indefinite; possibly perennial; plants creeping extensively, the decumbent stems branching freely and rooting at the nodes; prophylla 10-15 mm. long; erect flowering culms 5-13 cm. tall; internodes less than 1 mm. thick, glabrous, hollow, the lumen small; nodes glabrous or somewhat bearded; leaf sheaths flattened, mostly overlapping, glabrous except for ciliation on the overlapping margin; collar and throat ciliate; ligule a minute membrane, 0.1-0.2 mm. long; leaf blades flat, ovate 3-10:1, mostly glabrous, the base of the blade usually truncate and contracted into a very short pseudopetiole. Peduncles mostly included, the uppermost sheath bearing a rudimentary blade at the apex, just below the racemes; inflorescence of 2-4 spreading racemes borne along a short, flattened common rachis up to 6 mm. long; individual racemes 8-24 mm. long, the rachis flattened, 0.5-0.7 mm. wide; pedicels minute, ca. 0.2 mm. long; spikelets in 2 rows. Spikelets orbicular, rather flat, 0.9-1.2 mm. long, 0.8-1.0 mm. wide; first glume absent; second glume and lower (sterile) lemma as long as the spikelet, hyaline, each bearing 2 faint nerves at the margins; midribs not present; bracts usually glabrous, tending to disintegrate at maturity; upper (fertile) floret as long as the spikelet; lemma finely striate, not very convex, becoming reddish at maturity, its margins flattened over the edges of the slightly convex palea, forming a rim; anthers 3, purple, 0.3 mm. long; styles 2, separate; stigmas purple; caryopsis orbicular, 0.7-0.8 mm. long, rather flat. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Creeping on wet roadsides or in water of ditches, mostly at low altitudes near both coasts. July to December. Limón, Santa Rosa,

Puerto Viejo, Siquirres, Osa Peninsula. Two old specimens are known from the San José area, but the elevation seems anomalous. Southern Mexico to Panama, northern South America to Ecuador and Paraguay; West Indies.

***Paspalum paniculatum* L.**, Syst. Nat. ed 10, 2:855. 1759. An extensive synonymy is given by Chase. Figure 162.

Caespitose perennial in large clumps; plants erect; culms mostly 75-150 cm. tall, branching from the lower and middle nodes; prophylla up to 8 cm. long; internodes glabrous, 3-6 mm. thick, collapsed in drying; nodes prominent, sparsely to conspicuously silky-bearded; leaf sheaths mostly overlapping; overlapping margin finely ciliate; lower sheaths usually densely papillose-hispid, the upper more or less hispid to nearly glabrous; ligule a thin brown membrane, 0.5-1.0 mm. long; leaf blades flat, lax, mostly 17-35 cm. long, 13-24 mm. wide, the terminal one much smaller; base usually broad and rounded to the sheath apex; midrib prominent, white, keeled beneath; surfaces more or less papillose-pilose, sometimes densely so. Inflorescences terminal on leafy culms; peduncle exserted up to 15 cm., glabrous except near the bearded apex; panicles 6-25 cm. long, open-cylindrical; central rachis angled and grooved, glabrous; racemes usually 18-70, racemose along the rachis, some of them verticillate; bases or pulvini bearded with tufts of long, silky hairs up to 4 mm. long; racemes spreading, often arcuate, the lower ones 4-11 cm. long, the upper ones successively shorter; rachis of individual racemes triquetrous, slender, 0.3-0.5 mm. wide, bearing scattered fine elongate hairs on the margins. Spikelets paired on each side of the midrib, the terminal one on slender pedicel ca. 1 mm. long, the other on a shorter pedicel; spikelets obovate 1.2-1.4:1, blunt, 1.2-1.5 mm. long, finely puberulent, brown or purple, often with dark splotches; first glume absent; second glume and lower (sterile) lemma hyaline, equal, as long as the spikelet, 3-nerved; upper (fertile) floret ca. as long as the spikelet, stramineous, finely striate; lemma convex, the palea similar, flat; anthers 3, deep purple, 0.5-0.8 mm. long; styles 2, separate; stigmas purple; caryopsis circular, ca. 0.8 mm. long, tan. Chromosome number $n = 10$ from Costa Rican and Venezuelan specimens.

Common in disturbed areas, mostly at low elevations near both coasts, also in the Meseta Central, where it occurs to 1,500 m.; roadsides, ditches, flood plains, marshes, often on forest margins or in partial shade. Blooming yearlong, probably more abundantly during the rainy season. Southern Mexico to Argentina; West Indies; introduced in tropical climates of the Old World.

This species is quite weedy. It has no close relatives in the Costa Rican flora, but may possibly be confused with *P. corypheum*.

***Paspalum parviflorum* Rohde**, in Flügge, Monogr. *Paspalum* 98. 1810. Figure 149.

Diminutive caespitose annual in small tufts; plants 5-14 cm. tall, erect; culms branching from the base and lower nodes; prophylla 7-12 mm. long; internodes glabrous, purple, less than 0.5 mm. thick, hollow, thick-walled; leaf sheaths more or less keeled, overlapping, papillose-pilose with long hairs; ligule a minute membrane, 0.1-0.2 mm. long; leaf blades flat or folded, 1-5 cm. long, mostly less than 1 mm. wide, the midrib



FIG. 162. *Paspalum paniculatum*. A, leafy culm; B, inflorescence; C, spikelet pair; D, spikelet; E, plant base.

prominent beneath; surfaces and margins bearing elongated papillose-based hairs up to 5 mm. long. Peduncles mostly included in the uppermost sheath; inflorescence of 1-3 slender divergent racemes, each 1.0-1.5 cm. long, borne on a short rachis; rachis of individual racemes narrow, 0.3-0.4 mm. wide, triquetrous, strongly zigzag, the spikelets visible from both sides; spikelets borne in 2 rows, alternating and scarcely overlapping; pedicels ca. 0.2 mm. long, ciliate near the apex. Spikelets elliptical-obovate 2-3:1, blunt, 0.6-0.7 mm. long; first glume absent; second glume and lower (sterile) lemma hyaline, weakly 2-nerved near the margins, hyaline and easily disintegrating at maturity; margins of lower lemma and second glume bearing minute, peg-like hairs, presenting a roughened or pebbly appearance under low magnification; upper (fertile) floret about as long as the spikelet, stramineous; anthers 3, 0.3-0.5 mm. long, dark orange; styles 2; stigmas purple.

Paspalum parviflorum was previously known from Panama, Venezuela, Surinam, Brazil, French Guiana, and Puerto Rico. The only Costa Rican collection is the following: Guanacaste, 2 km. E of CIA on road to Las Ánimas, elevation 200 m., dry tuff outcrop in open *Byrsonima-Curatella* savanna, 4 December 1968, P. & D. 11531. Chromosome number $n = 10$ from the above specimen. This diminutive species is most closely related to *P. multicaule*, *P. clavuliferum*, and *P. pictum*.

Paspalum pectinatum Nees in Trin., Gram. Icon. 1:pl. 117. 1828. Figure 163.

Densely caespitose perennial in hard tufts, the bases of the plants buried below soil level and the foliage frequently burned off; culms erect; foliage mostly at the base of the plants or on the lower half of the culms; culms unbranched, 30-100 cm. long; internodes 1.5-2.5 cm. thick, hollow, glabrous; nodes not prominent; basal sheaths disintegrating into fibers; lower sheaths glabrous near the base and more or less hirsute toward the apex; upper leaves reduced to bladeless sheaths; ligule a brown membrane, 0.5-1.0 mm. long, with dense tufts of long hairs, up to 8 mm. long, behind it; leaf blades 11-65 cm. long, 3-7 mm. wide, somewhat revolute, the midrib prominent below; surfaces densely hirsute or velvety, the hairs 2-4 mm. long. Peduncles slender, exserted 3-15 cm. from the uppermost bladeless sheath, the apex silky-bearded; inflorescences solitary, terminal, 5-7 cm. long, consisting usually of a strict pair of conjugate racemes, sometimes with a third raceme a short distance below; rachis flattened, 2.0-2.5 mm. wide, with a membranaceous border and a prominent midrib; margins ciliate or somewhat toothed; apex of rachis protruding beyond the spikelets as a naked point; pedicels very short, 0.5 mm. long or less; spikelets solitary, densely overlapping in 2 rows. Spikelets cordate-ovate 2.2-2.3:1, strongly dorsally flattened, papery, 4.5-6.7 mm. long; first glume absent; second glume as long as the spikelet, acute, usually 3-nerved, with a wide papery wing; lower (sterile) lemma much narrower than the second glume, ovate, acute, flattened, 3-nerved, the margins bearing a dense row of spreading, pustulose-based hairs up to 2 mm. long, their tips extending beyond the margins of the second glume; back of the lemma with a few pustulose-based hairs; upper (fertile) lemma ovate 3:1, firm but not rigid, strongly dorsally flattened, 3.5-4.5 mm. long, minutely ciliate at the acute tip; palea similar and of equal length; lodicules 2, truncate; anthers 3, ca. 2.2 mm. long; styles 2, divergent; stigmas purple. Chromosome number $n = 10$ from Nicaraguan and Salvadorian specimens.

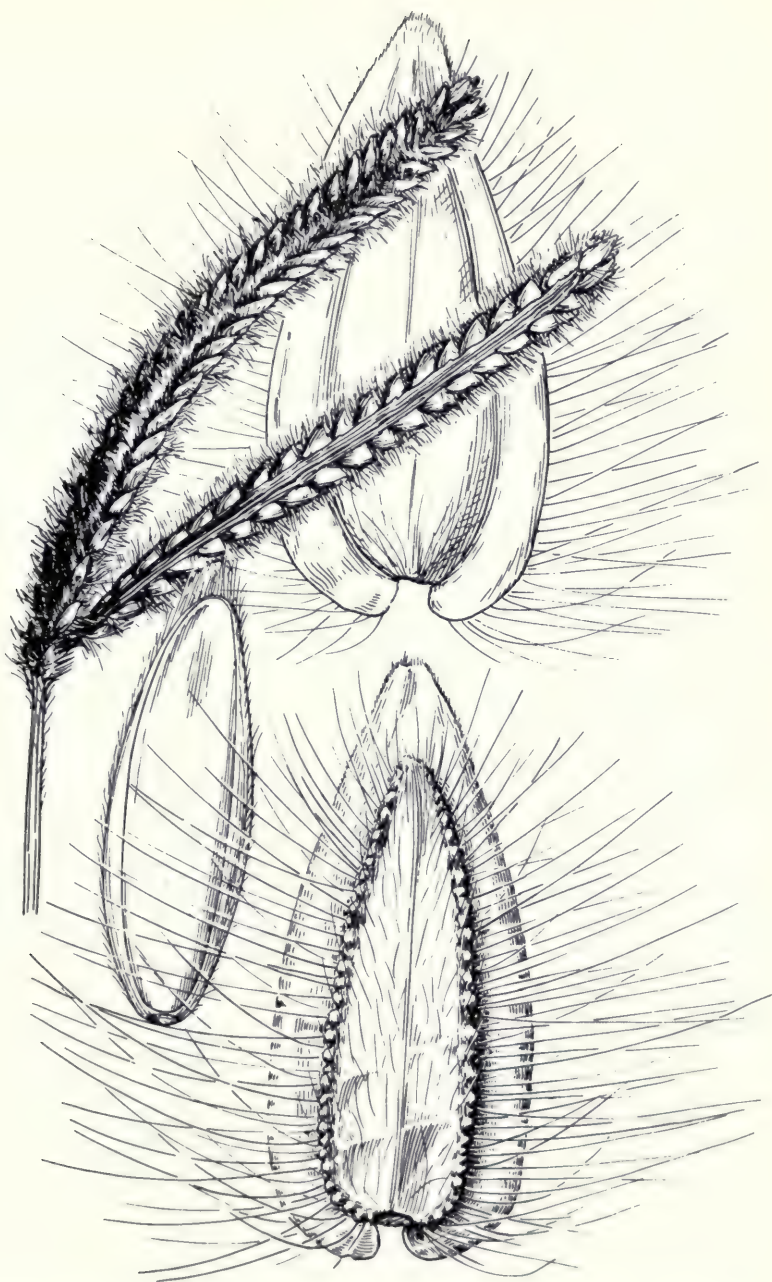


FIG. 163. *Paspalum pectinatum*. Inflorescence, two views of a spikelet, fertile floret.

Rare or overlooked; dry savannas near the CIA, from the La Cruz area to Liberia, Buenos Aires, Savanas de Tigre, Guacimo, Paso Real, Surubres; elevations 200-400 m. April to August. Southern Mexico to Honduras, El Salvador, Nicaragua; Costa Rica and Panama to Colombia and Brazil.

This species, *P. stellatum*, and *P. humboldtianum* are placed by Chase in the subgenus *Ceresia*, characterized by flattened or winged rachises and silky or strongly ciliate spikelets.

***Paspalum pictum* Ekman, Ark. Bot. 10:17:11, pl. 1, fig. 6. 1911. *P. maculatum* Nash, N. Amer. Fl. 17:186. 1912.**

Caespitose annual, in small tufts; plants 25-60 cm. tall, erect; culms branching from the lower nodes; internodes ca. 1 mm. thick, hollow, glabrous; nodes glabrous; sheaths longer or shorter than the internodes, keeled, glabrous, with thin hyaline margins; ligule a thin brown membrane, 1.0-2.2 mm. long; leaf blades folded, the distinction between sheath and blade obscure; lower blades up to 20 cm. long, 1.5-3.0 mm. wide, the upper blades much reduced, the uppermost sheath often bladeless; lower margins of blades with a few elongate, pustulose-based hairs, up to 5 mm. long. Peduncles glabrous, exserted 5-10 cm. or some included in the sheaths; inflorescences terminal on the main culm or on leafy branches; racemes 1-3, borne on a short common rachis 0.5-3.0 cm. long; racemes diverging, the rachis narrow, flattened, 0.7 mm. wide, arcuate, 3-7 cm. long, bearing a few elongate hairs at the base. Spikelets paired, crowded; pedicels glabrous, ca. 0.6 mm. long. Spikelets obovate 5:4, blunt, 1.0-1.1 mm. long, strongly plano-convex; first glume absent; second glume and lower (sterile) lemma hyaline, both slightly shorter and narrower than the upper (fertile) floret, whose edges are exposed; second glume with 0-3 nerves; sterile lemma 4-5-nerved, the lateral nerves paired near the margins; both glume and sterile lemma purple-splotted near the apex and sometimes on the back; fertile lemma strongly plano-convex, the surface conspicuously tuberculate except near the apex; palea similar, flat; anthers 0.2-0.3 mm. long, purple; styles 2, separate; caryopsis whitish, with a purple splotch at the apex between the 2 separate styles.

This species is known from Costa Rica only by a single collection, *Pittier 4474*, which is the type of *P. maculatum* Nash. A fragment of this collection is in US. It was collected on the Boruca savannas in November 1891.

***Paspalum pilosum* Lam., Tabl. Encycl. 1:175. 1791. Figure 164.**

Caespitose perennial; culms 50-130 cm. long, ascending or spreading, branching from the base and middle nodes; internodes 1-3 mm. thick, hollow, glabrous to densely pilose; nodes densely pilose-bearded to glabrous; leaf sheaths keeled, glabrous or papillose-pilose, especially toward the summit; overlapping margin densely and finely ciliate; collar sometimes bearded; ligule a thin brown membrane, 0.6-2.5 mm. long, a row or tuft of elongate silky white hairs, up to 6 mm. long, behind it; leaf blades linear, up to 25 cm. long, 5-10 mm. wide; midrib white, prominently keeled below; surfaces papillose-pilose on both sides; margins ciliate. Peduncles 1-3 from the terminal sheath; sometimes one additional from the sheath below, exserted 1-25 cm., glabrous or finely pilose, silky-bearded at the apex; racemes solitary, slightly arched, 6-16 cm. long; rachis 1.0-1.5 mm.

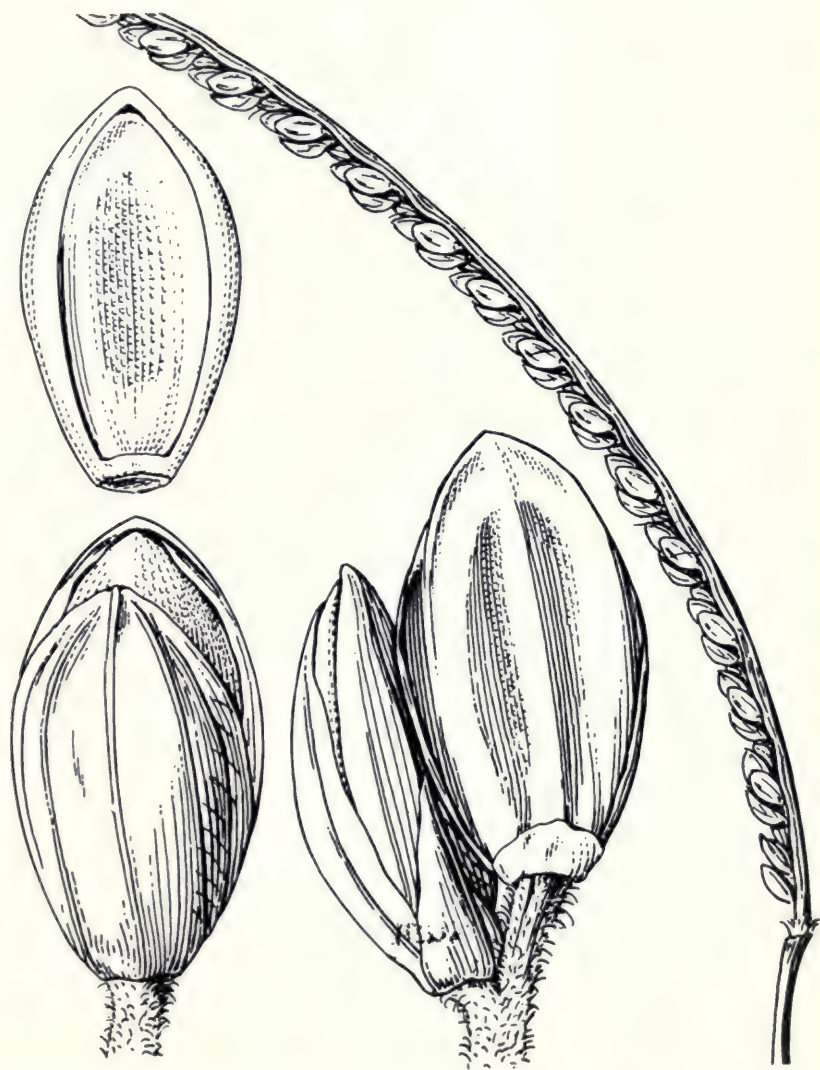


FIG. 164. *Paspalum pilosum*. Inflorescence, spikelet pair, single spikelet, fertile floret.

wide, its margins somewhat incurved, bearing scattered long weak hairs; spikelets paired on each side of the prominent midrib; terminal spikelet of each pair on a hispid pedicel ca. 1 mm. long, the other spikelet on a very short reflexed pedicel. Spikelets glabrous, strongly plano-convex, obovate 1.8-1.9:1, 2.6-3.2 mm. long, dimorphic; terminal spikelet of each pair with a very short, truncate membranaceous first glume or none; lower spikelet of each pair usually with a narrow, acuminate, 1-nerved first glume up to 2 mm. long, rarely lacking a first glume; second glume slightly shorter than the spikelet, 2.4-3.0 mm. long, 5-nerved; lower (sterile) lemma as long as the spikelet, usually 5-nerved, or the midnerve suppressed; apex blunt, forming a rim around the tip of the fertile floret; lower lemma enclosing a 2-nerved membranaceous palea nearly as long, usually bearing 3 well-developed anthers; upper (fertile) floret ovate, 2.5-2.8 mm. long, the lemma strongly convex, conspicuously striate, whitish; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 1.0-1.2 mm. long; styles 2, separate; stigmas plumose, deep purple. Chromosome number $n = 40$ from Costa Rican and Venezuelan specimens.

Widespread, mostly on the Pacific slope, at altitudes from 380-1,200 m.; common in scattered sites, on savannas, roadsides, pastures, and disturbed areas; rather weedy. Blooming July to January. Hda. Guachipelin to the Meseta Central; General Valley; Cariblanco; Moravia de Chirripó. Belize to Panama and northern South America to Bolivia and Brazil; Trinidad.

***Paspalum plicatum* Michx.**, Fl. Bor. Amer. 1:45. 1803. Figure 165.

Common and weedy, sea level to 600 m. elevation, rarely up to 1,200 m.; open disturbed areas, roadsides, savannas, beaches, on both Pacific and Caribbean slopes; often forming large colonies. Blooming yearlong, but most abundantly from April to September. The various members of the *P. plicatum* complex range from the southeastern United States to Argentina and the West Indies.

This species is a member of the informal group *Plicatula* of Chase. The species all have deep brown fertile florets. *Paspalum convexum*, *P. boscianum*, and *P. centrale* belong to this group. Their taxonomy is intricate and is complicated by polyploidy and cytological irregularities.

KEY TO VARIETIES OF *Paspalum plicatum*

- 1a. Foliage entirely glabrous var. *glabrum*
- 1b. Leaf blades and sometimes sheaths bearing pubescence 2
 - 2a. Sheaths and blades densely long-pilose var. *villosissimum*
 - 2b. Sheaths glabrous; upper surfaces of leaf blades hairy near base var. *plicatum*

***Paspalum plicatum* var. *plicatum*.**

Caespitose perennial; plants 70-150 cm. tall, the culms erect to arching, branching sparsely from the lower and middle nodes; internodes compressed, glabrous; nodes glabrous; leaf sheaths keeled, mostly overlapping, glabrous or nearly so; ligule a thin



FIG. 165. *Paspalum plicatulum*. Inflorescence, two views of a spikelet with wrinkled sterile lemma, fertile floret.

brown membrane, 1.0-3.5 mm. long; leaf blades flat, folded near the base, up to 43 cm. long, 6-12 mm. wide, the lower surface glabrous, the upper surface sparsely to densely long-pilose near the base; uppermost leaf blade very reduced or obsolete. Peduncles included in the uppermost sheath or exerted up to 17 cm.; inflorescences terminal on the main culm or leafy branches; panicles 6-22 cm. long, composed of 2-14 solitary racemes borne along an angled and grooved central rachis; individual racemes with a tuft of long hairs at the base; lowermost racemes 3-11 cm. long, the upper ones progressively shorter; rachis 0.7-1.1 mm. wide, zigzag; spikelets normally paired and the raceme thus 4-rowed, sometimes one member of the pair abortive or lacking, and the raceme hence 2- or 3-rowed. Spikelets usually 2.4-2.8 mm. long, elliptical-obovate 1.4-1.5:1, strongly plano-convex, grayish, or brownish when fully mature; first glume absent; second glume 5-7-nerved, slightly shorter than the spikelet, usually appressed-pubescent, occasionally glabrous; lower (sterile) lemma 5-nerved, glabrous, transversely wrinkled within the margin; upper (fertile) floret nearly as long as the spikelet, rigid, longitudinally striate, deep chestnut brown, strongly convex; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 1.5-1.7 mm. long; styles 2, separate; stigmas purple. Chromosome number of *P. plicatum* var. *plicatum* is $n = 20$ from numerous Central American collections.

***Paspalum plicatum* var. *villosissimum* Pilger, Bot. Jahrb. Syst. 30:131. 1901.**

This variety differs from var. *plicatum* in stature, being usually 55-100 cm. tall, and in the usually densely pilose sheaths and blades. The leaf blades are narrower, usually 2-5 mm. wide and densely pilose. Inflorescence 7-12 cm. long, of 2-6 racemes, the lowermost 3-7 cm. long, the upper shorter; rachis zigzag, 0.5-0.7 mm. wide. Spikelets 2.2-2.7 mm. long, obovate 1.4-1.7:1; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, 5-nerved; glume appressed-pubescent, the lemma glabrous.

Dry *Curatella-Byrsonima* and *Crescentia* savannas at low elevations, northwestern Guanacaste from the La Cruz area to Liberia. June to July. Most chromosome counts of this variety have indicated that it is diploid, with $n = 10$; however several of our Costa Rican accessions have had $n = 20$, with considerable meiotic irregularity.

***Paspalum plicatum* var. *glabrum* Arech., Anales. Mus. Nac. Montevideo 1:58. 1894.**

No Costa Rican collections of this variety have been identified, but it may occur. The plants, like those of var. *villosissimum*, are generally smaller and more slender than those of var. *plicatum*. Chromosome number $n = 10$ from a Mexican collection.

***Paspalum pulchellum* Kunth, Mém. Mus. Hist. Nat. 2:67. 1815. Figure 166.**

Caespitose perennial in small clumps; plants 15-55 cm. tall, erect; culms unbranched, slender; internodes less than 1 mm. thick, hollow, thin-walled, glabrous; nodes contracted, upwardly bearded; bases of the sheaths also bearded; foliage mostly aggregated

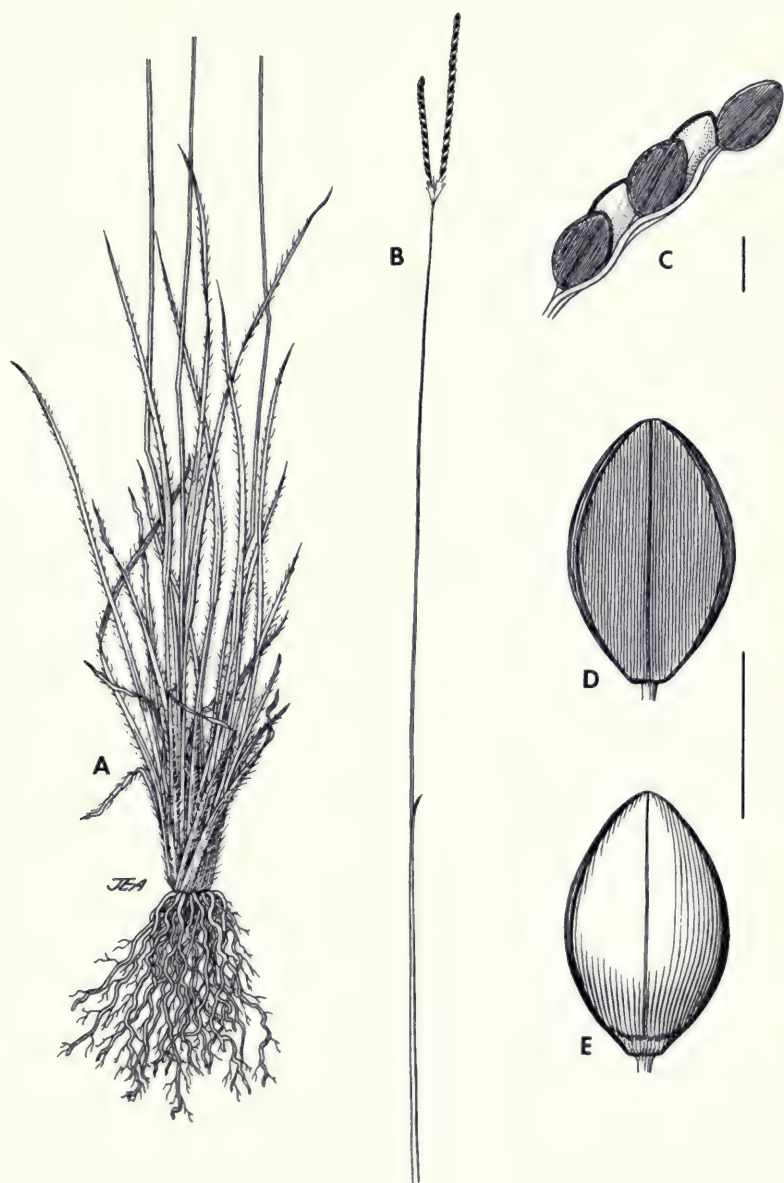


FIG. 166. *Paspalum pulchellum*. A, plant habit; B, inflorescence; C, portion of a raceme; D, spikelet, showing sterile lemma; E, spikelet, showing exposed back of fertile lemma.

near the base of the plants, the upper parts of the culms nearly naked, with elongated internodes and short or obsolete leaf blades; lower sheaths glabrous or more or less appressed-silky; the knotty bases of the plants often densely silky; upper sheaths nearly glabrous; ligule a minute membrane, 0.2-0.3 mm. long; leaf blades up to 20 cm. long, 1-2 mm. wide, usually folded or involute, usually copiously papillose-pubescent with spreading hairs up to 4 mm. long. Peduncles included in the uppermost bladeless sheath or exerted up to 10 cm.; inflorescences terminal on the culms, solitary, of 2-4 racemously arranged divergent racemes borne along a short flattened rachis ca. 5 mm. long; a tuft of silky hairs at the base of each raceme; individual racemes 2-7 cm. long; rachis flat, zigzag, up to 1 mm. wide, with 2 green lines flanking the white midrib; a solitary spikelet borne on the tip; spikelets solitary, alternating in 2 rows; pedicels up to 0.5 mm. long, ciliate. Spikelets 1.7-2.0 mm. long, obovate 1.1-1.6:1, rounded to a narrow tip; first and second glumes absent; lower (sterile) lemma as long as the spikelet, usually pinkish to deep purple, 3-nerved, the lateral nerves marginal, the edges inflexed over the margins of the upper (fertile) floret; fertile lemma strongly convex, shining, as long as the sterile lemma; palea similar, flat; lodicules 2, truncate; anthers 3, deep purple, 1.1-1.4 mm. long; styles 2, separate; stigmas purple. Chromosome number $n = 10$ from a Venezuelan specimen.

Occasional, dry *Curatella-Byrsonima* savannas, from Liberia toward the Nicaraguan border; elevations 75-200 m. June to July. Guatemala, Belize, eastern Honduras and Nicaragua; northern South America from Venezuela to French Guiana and Brazil; West Indies.

The racemes of this species are often striking because of the contrast between the purple sterile lemma and the shiny whitish fertile lemma. In one population from Liberia, however, plants with purple and yellow spikelets occurred together.

***Paspalum pumilum* Nees, Agrost. Bras. 52. 1829. Figure 167.**

Caespitose perennial in dense tufts; plants forming flat mats; culms 10-40 cm. long, branching from the base only; prophylls in the basal rosette evident, up to 2.5 cm. long; culm internodes 1.0-1.5 mm. thick, hollow, glabrous; nodes glabrous, not prominent; foliage mostly clustered near the base, the culm blades few, the uppermost leaf reduced or lacking a blade; sheaths and blades softly pubescent; ligule a thin membrane, 0.5-1.0 mm. long; leaf blades 5-10 cm. long, 3-7 mm. wide, flat, tapering rather abruptly to a cuspidate tip. Peduncle included or exerted up to 6 cm.; inflorescence terminal, usually of a nearly conjugate pair of racemes, sometimes a third one borne below them; racemes divergent, often curved, 2.5-4.0 cm. long, slender, the spikelets solitary, borne in 2 rows. Spikelets ovate-elliptical, rounded at the tip or barely acute, glabrous, 1.5-1.8 mm. long, 1.1-1.2 mm. wide; first glume usually absent, or present on a few spikelets, usually a minute deltoid nerveless scale, up to 0.2 mm. long, rarely up to 1.2 mm. long; second glume and lower (sterile) lemma equal, as long as the spikelet, 3-nerved, the lateral nerves close to the margin; upper (fertile) floret slightly shorter; lemma stramineous, not strongly convex; palea flat; lodicules 2, truncate; anthers 3, purple, 0.7 mm. long; styles 2, separate, naked below; stigmas purple.

This species is known in Costa Rica only by the following specimen: Heredia, 3 km. S of crater of Volcán Barba, full sun in roadway, prostrate in circular patches, chromosome number $n = 10$, *P. & D.*

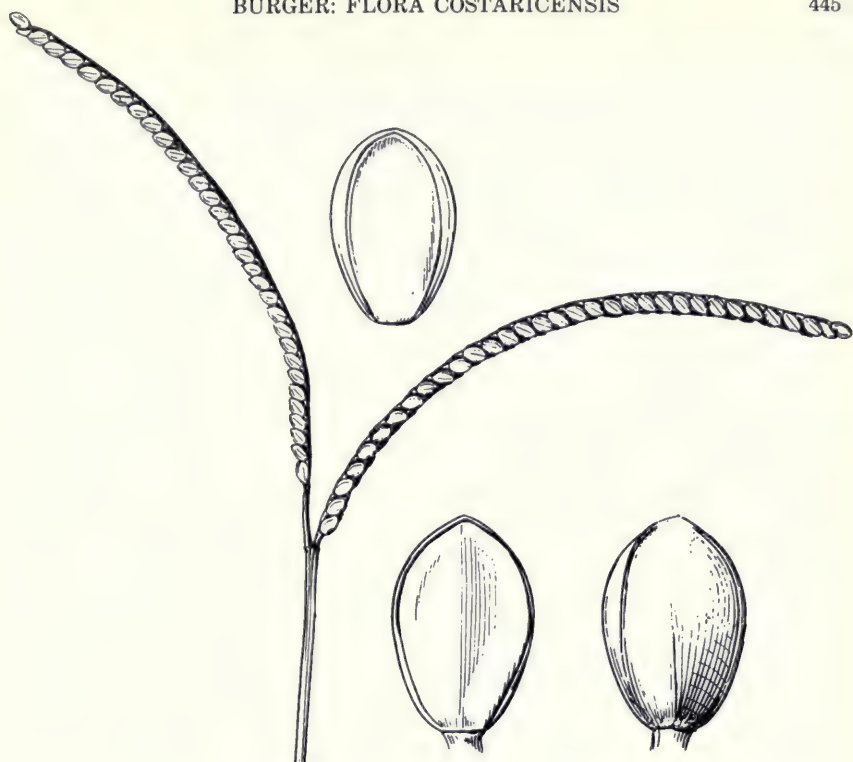


FIG. 167. *Paspalum pumilum*. Inflorescence, two views of a spikelet, fertile floret.

11777, 24 March 1969. West Indies and northern South America to Uruguay and Chile.

Paspalum reclinatum Chase, J. Wash. Acad. Sci. 33:316-317. 1943. Figure 146.

Duration indefinite; plants sprawling, the culms long-decumbent and rooting from the lower nodes, branching freely from the rooted portions; ascending portions 30-45 cm. long; prophylla up to 4 cm. long; internodes 1-2 mm. thick, hollow, glabrous; nodes glabrous, dark; leaf sheaths mostly shorter than the internodes, glabrous or the margin sparsely pilose; ligule a thin brown membrane, puberulent on the back, 0.7-2.0 mm. long; leaf blades 5-14 cm. long, 4-9 mm. wide, glabrous or puberulent above the ligule, flat and thin. Peduncle included in the uppermost sheath or short-exserted; panicles terminal on ascending leafy branches, 5-10 cm. long, open-cylindrical, ca. 4 cm. wide, made up of 6-11 ascending or drooping racemes, each 1.5-2.5 cm. long; rachis of racemes slender and pilose at the base, flattened and foliaceous, 1.0-1.2 mm. wide except at the base, tapering to a narrow apex that bears a solitary spikelet at the tip; spikelets borne alternately in 2 rows on slender, short-puberulent pedicels, the 2 rows slightly wider than the rachis. Spikelets 2.2-2.9 mm. long, ovate 2.0-2.3:1; first glume absent; second glume and lower (sterile) lemma equal, glabrous, 3-nerved, white or purplish, thin, slightly exceeding the

upper (fertile) floret; fertile floret ovate 2:1, blunt, 2.0-2.5 mm. long, the lemma smooth and shining, whitish, firm; palea of equal length and similar appearance, flat or slightly concave; anthers 3, purple, 1.5 mm. long; styles 2, separate; caryopsis elliptical 2:1, tan. Chromosome counts for all Costa Rican collections indicate $n = 30$.

Wet, seepy areas, mostly in moist canyons; elevation 1,500-2,100 m. February to June. This species was described from South America, and our Costa Rican collections are the first from Central America. Alto Paloma, Quebrada Corralillo (Rancho Redondo), Río Grande de Orosí, at the power dam 8 km. S of Tapantí.

The specimen from Alto Paloma (*P. & D. 11710*) was originally reported as *P. prostratum* Scribn. & Merr., but differs in pubescence and chromosome number from that species.

***Paspalum repens* Berg.**, Acta. Helv. Phys.-Math. 7:129, pl. 7. 1762. Figure 146.

Duration indefinite, probably perennial; culms up to 2 m. long, the lower parts creeping or floating in water, rooting abundantly from the nodes; internodes up to 1 cm. thick, hollow, thin-walled, glabrous; nodes glabrous, not prominent; leaf sheaths mostly overlapping, glabrous to papillose-pilose, often inflated; sheath auricles erect, pointed, 3-12 mm. long; dewlap and collar purple; ligule a ciliolate membrane, 2.5-3.5 mm. long; leaf blades usually 20-40 cm. long, 12-14 mm. wide, softly pilose. Inflorescences terminal on leafy branches; peduncles short, exserted 2-4 cm.; panicles densely ovoid, 10-16 cm. long, 4-9 cm. wide, the numerous ascending or spreading racemes whorled or solitary, dropping from the rachis when mature; longest racemes 4-7 cm. long; rachis of racemes flattened, 1.5-1.8 mm. wide, foliaceous, extending beyond the ultimate spikelet as a naked acuminate point; spikelets alternating in 2 rows on the lower side of each rachis, the 2 rows as wide as the rachis. Spikelets 1.8-2.0 mm. long, ovate 2.3:1, acute; first glume absent; second glume and lower (sterile) lemma hyaline, equal, as long as the spikelet; second glume with 2 marginal nerves; lower lemma 2-3-nerved; upper (fertile) floret shorter than the glume and lemma, ca. 1.8 mm. long, the lemma ca. 1.6 mm. long, obovate 2.1:1, firm, not rigid, blunt; lodicules 2, truncate; anthers 3, purple, 0.9-1.2 mm. long; styles 2, separate.

Occasional in swamps and ponds, sea level to 300 m. elevation; Taboga, Lagunas de San Bernardo, Marais de Sierpe, Río Colorado, 15 km. from Barro de Colorado. October to March. Southern Mexico to northern South America, southward to northern Argentina; West Indies. Chase (1910) formerly included *P. fluitans* (Ell.) Kunth of the United States under *P. repens*.

***Paspalum saccharoides* Nees** in Trin., Gram. Icon. 1. pl. 107. 1828. Figure 168.

Vigorous perennial; culms elongated, usually sprawling or drooping, hanging over embankments or bluffs, the bases hard, with coarse, thick roots; lower portions of culms rooting upon contact with the soil; internodes thick-walled, woody, 4-8 mm. thick, glabrous or appressed-pilose; nodes swollen; leaf sheaths overlapping, loose, glabrous, or pilose at the base; margins ciliate with delicate silky hairs; ligule a minute membranous

ridge, 0.2-0.3 mm. long, with a tuft of long, silky, erect hairs, up to 10 mm. long just behind it; midculm blades 10-40 cm. long, 5-13 mm. wide, rather thick and somewhat involute, pilose above and glabrous beneath; basal and uppermost leaf blades much reduced. Inflorescences terminal on leafy culms; peduncles exerted up to 16 cm.; panicle fan-shaped or pyriform, 12-30 cm. long, the numerous slender flexuous racemes fascicled along a slender rachis up to 7 cm. long; axils and pulvini long-silky; racemes 9-25 cm. long, densely silky with white hairs; rachis triquetrous, ca. 0.5 mm. wide, the angles scabrous; spikelets solitary, in 2 rows on the lower 2 sides of the rachis; pedicels slender, ca. 0.5 mm. long. Spikelets ovate 3-4:1, acute, 2.0-3.0 mm. long, with a slightly auriculate base; first glume absent; second glume as long as the spikelet, thin, with 2 marginal nerves that are copiously ciliate with white, silky hairs 4-6 mm. long; midnerve rarely present; lower (sterile) lemma slightly shorter than the glume, 1.8-2.4 mm. long, glabrous, 2-nerved, thin; upper (fertile) floret 1.6-1.8 mm. long, ovate ca. 3:1, acute, firm, not rigid; palea similar to the lemma but slightly longer; anthers 3, yellow, 0.8-0.9 mm. long; caryopsis 0.8 mm. long, obovate with a nearly truncate apex bearing the persistent style base; embryo large, ca. one-third as long as the tan caryopsis.

Occasional, moist spots, mostly on the Caribbean slope at elevations from sea level to 1,200 m., on bluffs, road embankments, above streams; rare in the Meseta Central (Dos Ríos) and absent from Guanacaste; San Miguel (Alajuela); San Ramón to Naranjo, La Hon-

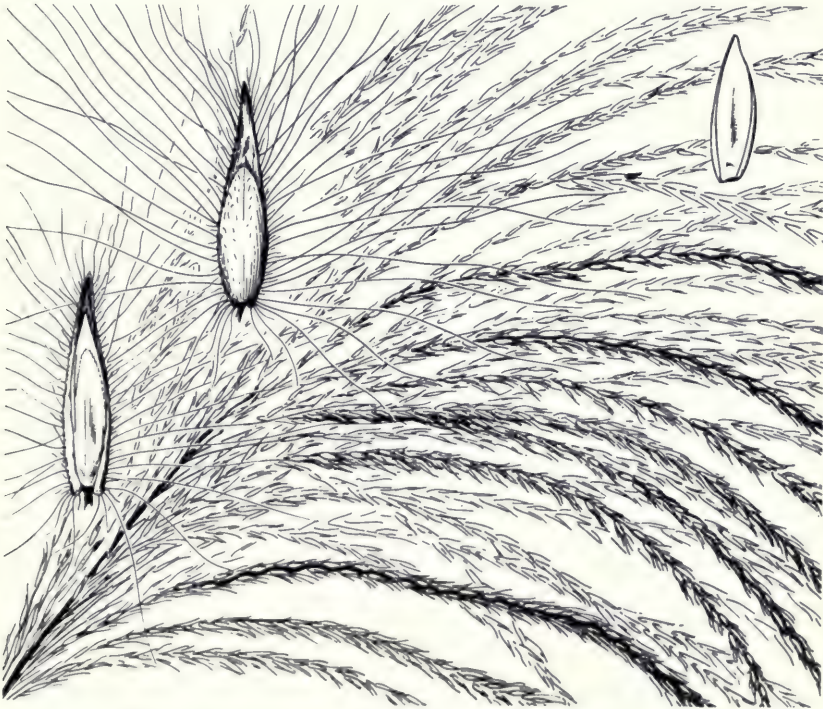


FIG. 168. *Paspalum saccharoides*. Inflorescence, two views of a spikelet, fertile floret.

dura, Cartago, Turrialba, Guapiles, San Vito, Limón. April to August. Costa Rica to northern South America and the West Indies.

This species is striking because of the plumose panicle. The spikelets are atypical for the genus *Paspalum*, being of delicate texture and having a rather thin fertile lemma. The spikelets are somewhat similar to those of some species of *Digitaria*, notably *D. insularis*; however, the chromosome number of *P. saccharoides* is $n = 10$, from Costa Rican specimens. The basic chromosome number of *Digitaria* is $x = 9$. *Paspalum saccharoides* has no close relatives in the genus and may deserve generic status of its own.

Paspalum scabrum Scribn., U.S.D.A. Div. Agrost. Bull. 4:36. 1897.

Duration indefinite, probably annual; culms to 110 cm. long, sprawling and rooting at the lower nodes, branching freely from the decumbent portions; prophylla up to 8 cm. long; culm internodes 2-3 mm. thick, hollow, retrorsely scabrous with short, sharp points; leaf sheaths longer or slightly shorter than the internodes, strongly scabrous on the ridges with minute, retrorse barbs; ligule a thin brown membrane, 2.0-2.5 mm. long; leaf blades ovate 4-7:1, flat, 8-12 cm. long, 13-28 mm. wide, finely papillose-pilose on both surfaces, the base rounded to a short pseudopetiole; midrib scabrous beneath. Inflorescences terminal on erect leafy branches; peduncle included in the uppermost sheath; rachis grooved and angled, stiff-pubescent; panicles 10-20 cm. long, up to 5 cm. wide, open-cylindrical, the racemes numerous, mostly whorled, 3-4 cm. long, falling as units from the rachis at maturity; rachis of racemes flat, foliaceous, 2.0-2.5 mm. wide, the midrib scabrous beneath; margins inflexed around the spikelets; tip extended beyond the ultimate spikelet as a naked point 3-4 mm. long; spikelets rather distant, forming a single row. Spikelets 1.7-2.0 mm. long, ovate 2:1, blunt, glabrous; first and second glumes absent; lower (sterile) lemma and upper (fertile) floret equal, as long as the spikelet; sterile lemma membranaceous, 3-nerved; fertile lemma smooth and shining, firm but not rigid; palea similar and of equal length; lodicules 2, truncate; anthers 3, yellow to purplish, 1.4-1.5 mm. long. Chromosome number $n = 10$ from a Costa Rican specimen.

This species, although striking because of its very scabrous foliage, is little known and apparently rare. It is known in Costa Rica from San Pedro de San Ramón (Cuesta del Toro), between San Ramón and Naranjo, and 10 km. E of San Mateo on the road to Atenas. The latter specimen grew in a shaded moist gully at 880 m. elevation. December to January. Guatemala and Nicaragua to Venezuela, Colombia, Ecuador, and Bolivia. *Paspalum scabrum* is similar to *P. candidum* in spikelet characters, but differs in foliage and in chromosome number.

Paspalum serpentinum Hochst. in Steud., Syn. Pl. Glum. 1:22. 1854. Figure 169.

Caespitose perennial in small tufts; culms erect, 60-100 cm. tall, unbranched; internodes up to 1.5 mm. thick, solid, glabrous; nodes glabrous, shrunken; foliage aggregated near the base of the plants, the upper parts of the culms with elongated internodes and

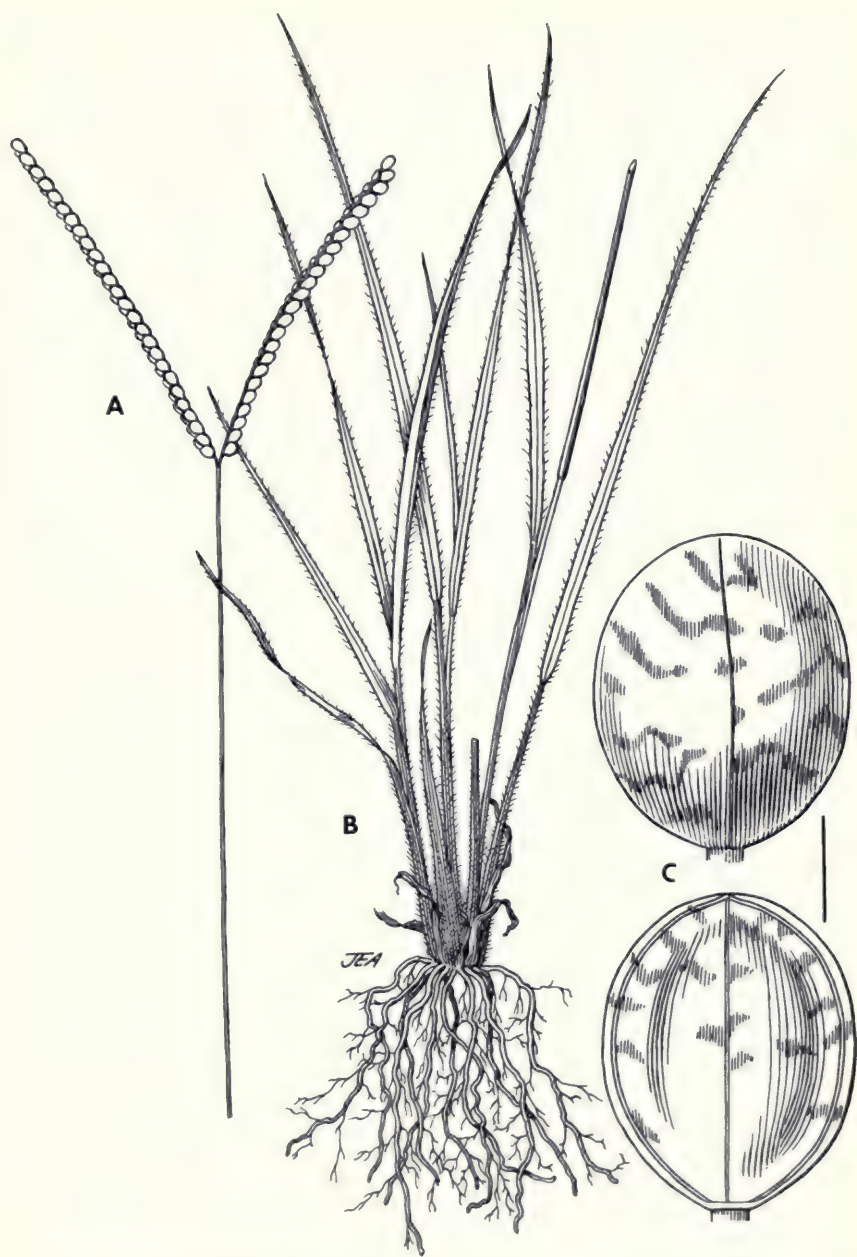


FIG. 169. *Paspalum serpens*. A, inflorescence; B, growth habit; C, two views of a spikelet, with mottled bracts.

nearly bladeless sheaths; lower leaf sheaths and blades densely grayish-pilose with papillose-based hairs up to 3 mm. long; lower sheaths longer than the internodes, upper ones shorter; ligule a thin membrane, 0.3-0.6 mm. long; lower leaf blades up to 30 cm. long, 3-4 mm. wide, flat or involute. Peduncles slender, exserted up to 20 cm.; inflorescences terminal on the simple culms, consisting of a conjugate pair of diverging racemes; apex of the peduncle with a tuft of silky hairs; individual racemes 3-7 cm. long, the rachis narrow, zigzag, triquetrous, 0.5-0.7 mm. wide; pedicels 0.5-1.0 mm. long; spikelets solitary in 2 rows, closely overlapping. Spikelets 2.5-2.8 mm. long, broadly elliptical 1.1-1.3:1, obtuse; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, glabrous, mottled with reddish brown lines that radiate inward from the margins of the bracts; lemma and glume 3-nerved, the lateral nerves very close to the margins; upper (fertile) lemma strongly dorsally flattened, broadly elliptical, whitish, finely striate; margins sharply inflexed, forming a flattened rim around the palea; palea convex, but the margins sunken beneath the rim of the lemma; lodicules 2, truncate; anthers 3, purple, 1.5 mm. long; styles 2, separate; stigmas purple; caryopsis tan, broadly elliptical, 1.9 mm. long, with a red line ca. one-third as long at the base opposite the embryo. Chromosome number $n = 10$ from a Nicaraguan specimen.

Dry savannas at low elevations. The only known Costa Rican specimen is the following: Guanacaste, 21 km. NW of Liberia, shallow dry soil, elevation 75 m., *Curatella-Byrsonima* savanna, 31 July 1966, *Pohl & Calderon 10175*. Belize, Honduras, Nicaragua, Panama; Trinidad and the Guianas.

***Paspalum setaceum* Michx., Fl. Bor. Amer. 1:43. 1803.**

Perennial, in small tufts from short, knotty rhizomes; plants 35-65 cm. tall; culms ascending, the internodes hollow, glabrous; nodes glabrous, dark; leaf sheaths shorter or longer than the internodes, glabrous except for the finely ciliate overlapping margin; dewlap and collar bearded; ligule a thin tan membrane, 0.3-0.5 mm. long, with a tuft of white hairs behind it; leaf blades flat, usually 8-19 cm. long, 7-11 mm. wide, the length 8-18 $\times$ the width; surfaces glabrous, the margins prominently pustulose-ciliate with hairs up to 4 mm. long. Peduncles terminal and axillary, 1-3 exserted up to 30 cm. from the terminal sheath, usually 1 included or exserted from 1 to all of the lower culm sheaths; inflorescence of 1 or 2 solitary racemes on a short rachis; individual racemes 4-8 cm. long, arcuate; rachis 0.7-0.8 mm. wide; spikelets paired, in 2 rows on each side of the midrib. Spikelets 1.5-1.7 mm. long, elliptic-obovate 1.2-1.3:1, blunt or very slightly pointed, strongly plano-convex; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, brown-speckled, sparsely to densely puberulent with capitate hairs; second glume 3-nerved; sterile lemma 2-nerved, the midnerve absent; upper (fertile) floret about as long as the spikelet, stramineous; lodicules 2, truncate; anthers 3, brown, 0.5-0.7 mm. long; styles 2, separate; stigmas purple; caryopsis subcircular, 1.2 mm. long, tan-striate, opalescent, a brown spot opposite the embryo. Chromosome number $n = 10$ from a Costa Rican specimen.

Sandy beaches of the Caribbean; Tortugero, Limón Airport, Río Banano, Cahuita; Puntarenas; usually rare. June to December.

This species belongs to a complex group of grasses which have been variously treated as a number of species, or as varieties of a single one. The most recent treatment, by D. J. Banks (*Sida* 2:4:269-284. 1966),

places all of these plants in nine varieties under *P. setaceum*. None of these varieties matches our plants very well. They come closest to *P. propinquum* Nash, Bull. New York Bot. Gard. 1:291. 1899. The description given above is derived entirely from Costa Rican specimens, which form a highly uniform group, quite unlike the temperate zone representatives of the group. Several of our specimens have old anthers trapped in the mature fertile floret along with a well-developed caryopsis. The plants are apparently largely cleistogamous, which may account for the multiplicity of forms in the group.

***Paspalum squamulatum* Fourn., Mex. Pl. 2:11. 1881. Figure 170.**

Plants perennial, caespitose but the culms decumbent and rooting at the lower nodes, branching freely from the rooted nodes; erect branches simple, 20-60 cm. long; prophylla prominent, 2.0-4.5 cm. long; internodes glabrous, hollow, 1-2 mm. thick; nodes glabrous, dark; leaf sheaths keeled, mostly longer than the internodes, glabrous except the finely ciliate overlapping margin; collar sometimes bearded; ligule a thin brown lacerate membrane, 2.5-4.5 mm. long; leaf blades mostly 7-11 cm. long, 8-13 mm. wide, dark green, flat, the midrib keeled beneath; base usually rounded; surfaces glabrous or more or less pilose, especially the upper. Peduncle slender, solitary, included or exerted up to 14 cm. from the terminal sheath. Inflorescence usually 4-8 cm. long, a raceme of usually 4-6 divergent racemes borne singly or paired along a flattened and channeled rachis; base of each raceme with a tuft of long hairs; individual racemes 2-8 cm. long; rachis triquetrous, 0.5-0.7 mm. wide, zigzag; spikelets paired on each side of the midrib. Spikelets glabrous, obovate 1.3-1.5:1, blunt, 1.5-1.8 mm. long, strongly plano-convex; first glume absent (a minute rudiment present on one specimen); second glume 1.3-1.7 mm. long, 3- or rarely 5-nerved, slightly shorter than the fertile lemma, which is exposed at the tip; lower (sterile) lemma as long as the spikelet, 3-nerved, lacking a palea; upper (fertile) floret 1.5-1.7 mm. long, obovate 1.2-1.3:1, 1.5-1.7 mm. long, whitish, striate, strongly convex; palea similar, flat; lodicules 2, truncate; anthers 3, brown, 0.8-0.9 mm. long; styles 2, separate; stigmas dark; caryopsis elliptic 1.2-1.3:1, strongly convex, whitish, opalescent. Chromosome number $n = 20$ from Costa Rican specimens.

Moist open or partially shaded sites, volcanoes of the Cordillera Central; Meseta Central; Canton de Dota; elevations 1,100-2,000 m. Blooming June to February. Mexico to Costa Rica.

Spikelets and vegetative habit of this species are similar to *P. nutans*, but the inflorescence is different.

***Paspalum standleyi* Chase, J. Wash. Acad. Sci. 17:146. 1927.**

Rhizomatous perennial, forming mats; culms simple, erect, arising from the rooted parts, 10-32 cm. tall; internodes up to 1 mm. thick, hollow, thick-walled, glabrous or the lower ones pilose; nodes appressed-pilose; leaf sheaths mostly overlapping, glabrous or pilose; nodes appressed-pilose; leaf sheaths mostly overlapping, glabrous or pilose, the overlapping margin conspicuously pilose-ciliate; foliage mostly aggregated on the lower portions of the culms, the upper blades much reduced or lacking; ligule a minute membrane, ca. 0.2 mm. long; leaf blades linear, rather blunt-tipped, 2.5-7.0 cm. long, 2.5-5.0 mm. wide, glabrous or sparsely pubescent; pseudopetiole 1.0-1.5 mm. long, densely

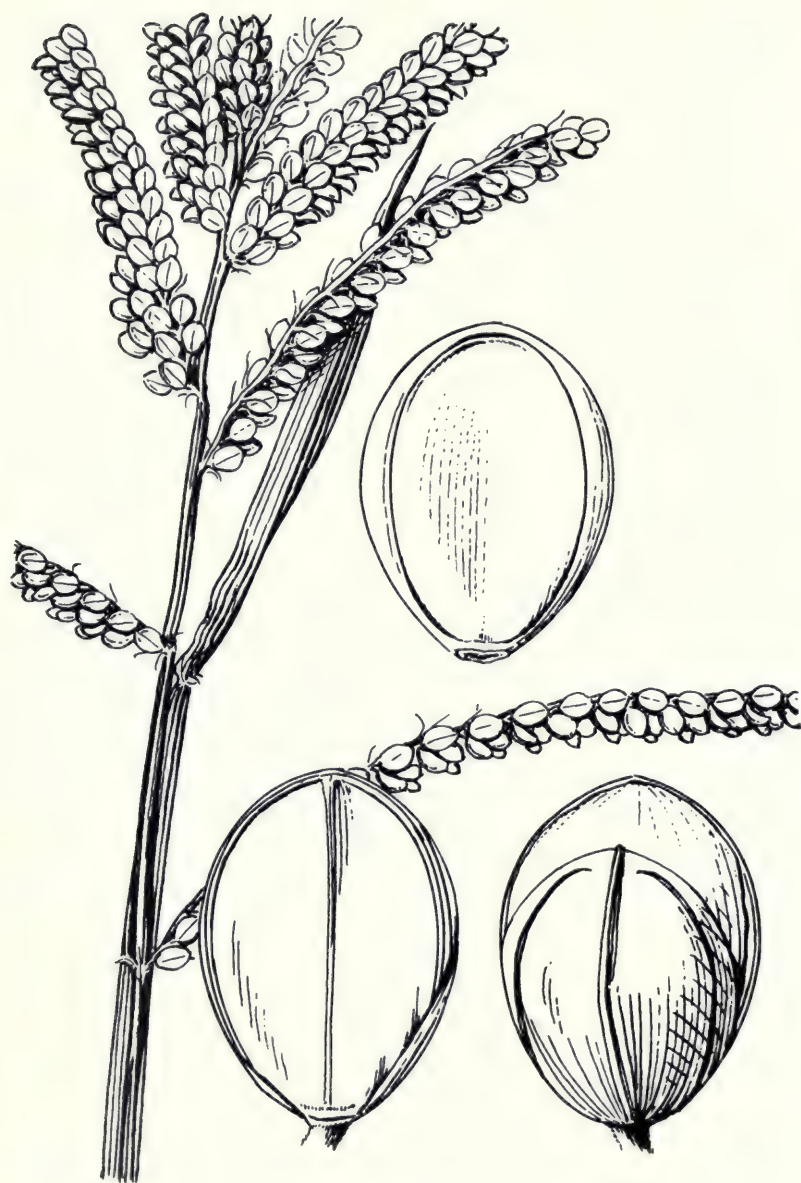


FIG. 170. *Paspalum squamulatum*. Inflorescence, two views of a spikelet, fertile floret.

bearded below. Peduncles exserted 1.5-3.0 cm.; inflorescences terminal on leafy culms, of 2-5 divergent racemes borne along a short, flattened rachis up to 10 mm. long; individual racemes 1-3 cm. long; rachis flattened, zigzag, 0.5-0.6 mm. wide, naked or bearing abortive spikelets for the basal 1 mm.; spikelets borne in 2 rows. Spikelets 1.4-1.5 mm. long, ovate 1.6-1.9:1, acute, strongly flattened, glabrous; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, each with 2 marginal nerves and lacking midribs; bracts thin; upper (fertile) lemma slightly shorter than the outer bracts, elliptical, firm but not rigid, finely striate; palea similar, flat; anthers 3, purple, 0.8-0.9 mm. long; pollen normal; caryopses developing.

Gravelly river banks and sand bars. This species was previously known only from the type, collected in Panama. I have recently found it in abundance along the Río Platano in Honduras. Our two Costa Rican collections are cited below. *Paspalum standleyi* is probably much more widespread in Costa Rica in suitable habitats.

Guanacaste, moist shady bank of Río Corobicí, Finca La Pacífica, elevation 80 m., 3 December 1968, *P. & D. 11516*; Puntarenas, bank of Río Grande de Terraba, 11 km. SE of Río Catarata, elevation 100 m., 12 December 1968, *P. & D. 11607*.

Paspalum standleyi was placed by Chase in the group *Parviflora*, consisting mostly of small annuals of dry savannas, whose chromosome numbers, as far as known, are all $n = 10$. Our two collections of *P. standleyi* are both $n = 20$, and the plants are rhizomatous perennials. In inflorescence structure and spikelets, they are very similar to *P. jimenezii*, a rare sterile triploid ($2n = 30$). It seems most probable that these two are closely related, and that *P. standleyi* is a parent of *P. jimenezii*.

***Paspalum stellatum* Humb. & Bonpl. in Flüge, Monogr. *Paspalum* 62. 1810. Figure 171.**

Caespitose perennial in dense tufts; culms 55-85 cm. long, erect, most of the foliage near the base; upper leaf blades much reduced; internodes few, elongated, less than 1.5 mm. thick, hollow, glabrous or the upper internodes and peduncle with a few appressed hairs; leaf sheaths nearly glabrous at the base, more or less pilose toward the apex, shorter than the internodes; ligule a short membrane, 0.2-0.3 mm. long, with a dense row of white hairs behind it; leaf blades up to 25 cm. long, 2-4 mm. wide, mostly involute; lower surface sparsely hirsute, the upper surface densely hirsute with hairs up to 5 mm. long. Peduncles slender, appressed-pilose, silky at the apex; inflorescences solitary, terminal on the unbranched culms, 3.5-10 cm. long, composed of a single arched raceme or rarely of 2 conjugate racemes; rachis broadly winged, 5-8 mm. wide, infolded about the spikelets; midrib flanked by narrow conspicuous green stripes and purplish line on each side; margins of rachis wide, thin and papery, russet or chestnut-colored; spikelets densely crowded in 2 rows on the lower side of the rachis, but scarcely visible because of the dense silky hairs of the bracts; pedicels very short, with a circle of diverging white hairs at the tip. Spikelets angular-obovate ca. 2:1, strongly flattened, 3.0-3.2 mm. long; callus densely bearded with erect silky hairs ca. half the length of the spikelet; first

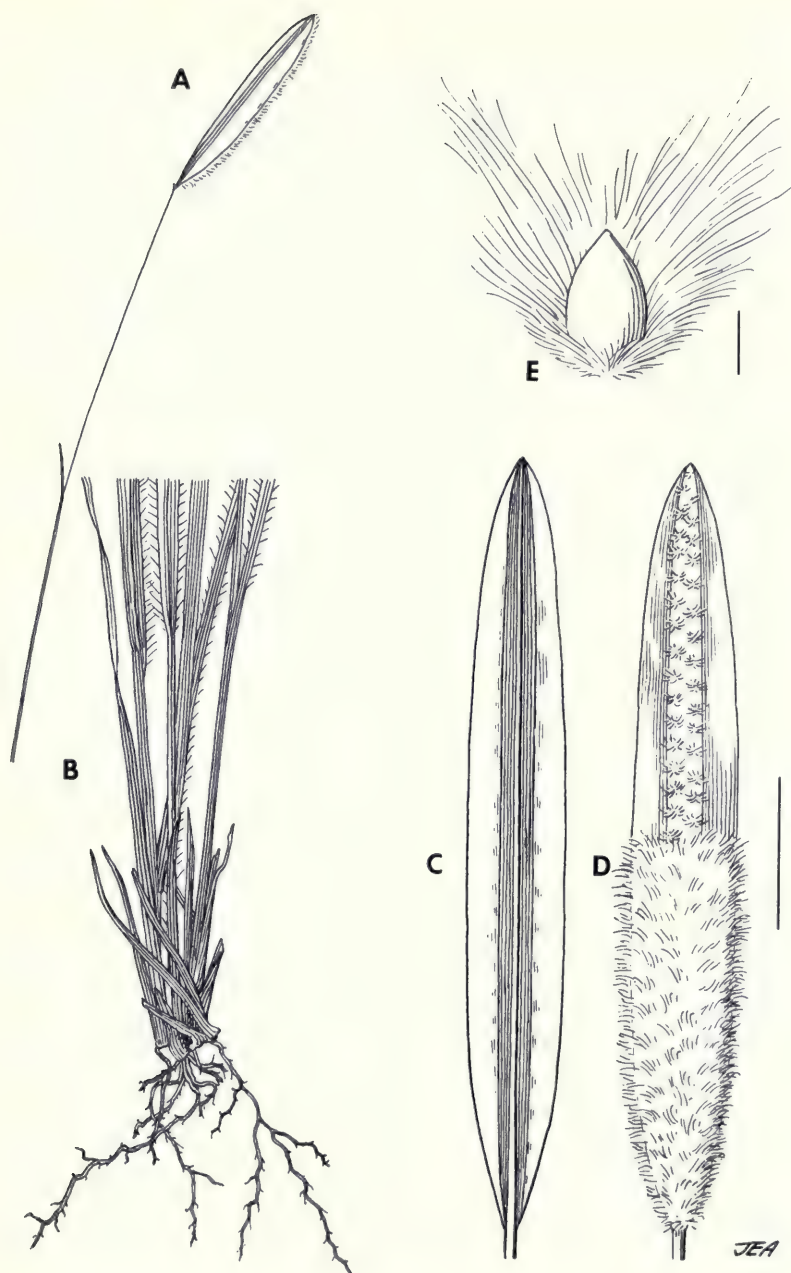


FIG. 171. *Paspalum stellatum*. A, inflorescence; B, plant base; C, rachis of raceme; D, spikelets and pedicels on the rachis; E, spikelet.

glume absent; second glume as long as the spikelet, flat, membranaceous, lacking a midrib, the 2 nerves marginal, thickened and corky on the upper half, densely ciliate with spreading white hairs, those near the base shorter, those on the upper margins pustulose-based, 3 mm. or more long; lower (sterile) lemma similar but narrower, marginally 2-nerved, 2.5-2.9 mm. long; upper (fertile) floret obovate 2.3:1, minutely stipitate; lemma firm but not rigid, whitish; palea similar, of equal length; lodicules 2, truncate; anthers 3, orange, 1.7-2.0 mm. long; styles 2, separate; stigmas brown; caryopsis ca. 1.2 mm. long, obovate 1.6:1, tan.

Rare; Boruca savannas; elevation ca. 450 m. September to December. Southern Mexico to northern South America, southward to Argentina; Hispaniola.

***Paspalum tonduzii* Mez, Fedde. Rept. Sp. Nov. 15:72. 1917.**

Caespitose perennial; height unknown; culms erect or geniculate, unbranched; nodes bearded; leaf sheaths longer than the internodes, keeled, papillose-pilose; ligule a very short membrane; leaf blades flat, up to 30 cm. long and 10 mm. wide, papillose-pilose above and below; midrib broad, whitish. Inflorescence solitary, terminal; peduncle included; panicle 9-11 cm. long, of 7-8 ascending racemes; racemes 3-5 cm. long; rachis deep purple, ca. 0.7 mm. wide; spikelets mostly paired, some of the lower ones abortive. Spikelets 2.0-2.1 mm. long, obovate 1.7-1.9:1; bracts thin and delicate, mottled purple and golden; first glume absent; second glume slightly shorter than the spikelet, 3-nerved, occasionally finely puberulent near the apex; lower (sterile) lemma as long as the spikelet, 3-nerved; upper (fertile) lemma stramineous, finely striate.

This species is known only from the type specimen, cited below. The description was compiled from a type fragment and photograph in US and from descriptions by Mez and Chase. HOLOTYPE: San José, Plantations de maíz de Santa Maria de Copey, 1,800 m., February 1908, *Tonduz 11767*.

***Paspalum turriforme* Pohl, *sp. nov.* Figure 172.**

Gramen altum, perenne, grex *Virgata* pertinens, a *P. densum* Poir. spiculis acutioribus, longioribus (2.2-2.5 mm. vs. 1.7-1.9 mm.), angustioribus (1.4-1.5:1 vs. 1.0-1.2:1), panicula longiore, racemis numerosis (ad 150) recedit, et a *P. plenum* Chase spiculis glabris brevioribus (2.2-2.5 mm. vs. 2.5-3.0 mm.), latioribus (1.2-1.5 vs. 1.7-2.3:1) abhorret.

Tall, vigorous caespitose perennial in dense clumps; plants up to 3 m. tall, erect; culms unbranched; culm internodes up to 8 mm. thick, hollow, glabrous; nodes glabrous or appressed-pilose; basal leaves numerous, the sheaths strongly keeled, glabrous to sparsely hispid, closely distichously overlapping; culm sheaths keeled, overlapping, glabrous except the papillose-ciliate overlapping margin; dewlap and collar densely long-bearded with papillose-hispid hairs; ligule a firm tan lacerate membrane, 2-5 mm. long; a dense tuft of stiff elongate hairs on the upper blade surface just behind the ligule; leaf blades 40-95 cm. long, the base narrow, strongly keeled and channeled; blades widest at the middle, flat, 12-17 mm. wide; margins strongly scabrous, cutting; tip attenuate. Peduncles solitary, terminal, exserted up to 13 cm.; panicle dense, purple, narrow, spirelike, 30-50 cm. long, of 40-150 closely placed ascending or drooping racemes; common rachis strongly angled and grooved, scabrous; rachis of individual

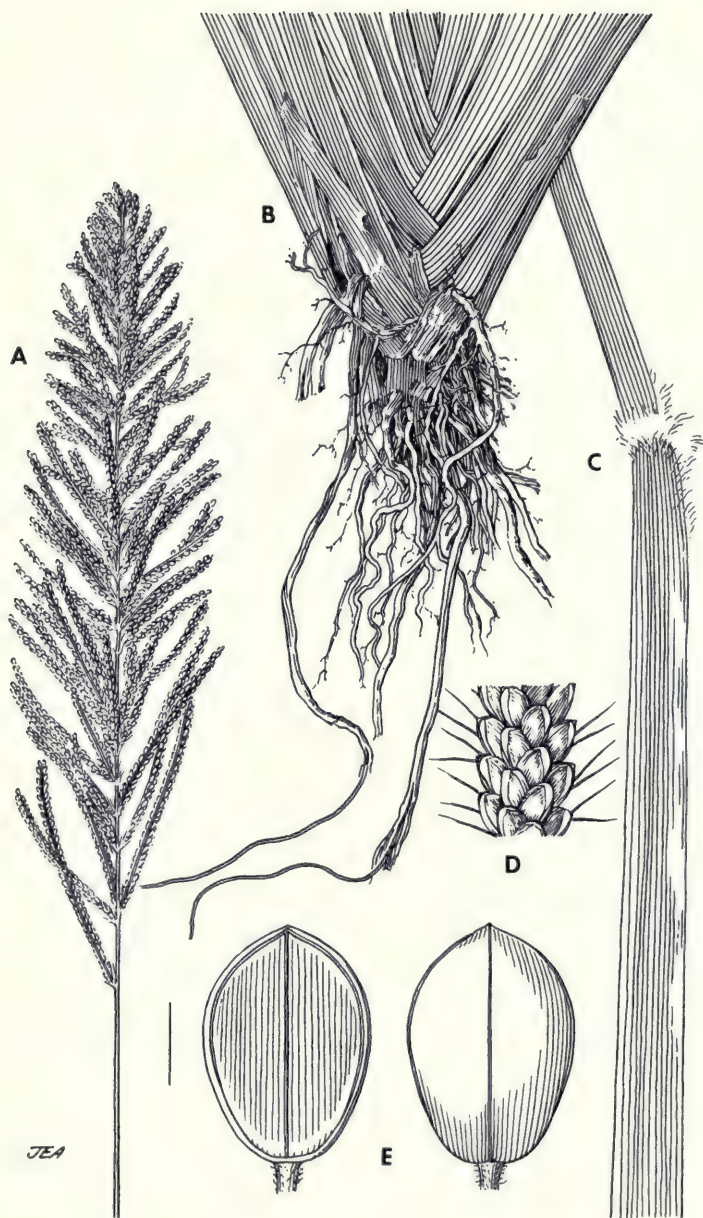


FIG. 172. *Paspalum turriforme*. A, panicle; B, culm base, showing distichous leaf sheaths; C, leaf sheath and blade; D, portion of a raceme; E, two views of a spikelet.

racemes purple, 1.2-1.5 mm. wide, lower racemes 7-11 cm. long, the midrib prominent on the naked side; base with a tuft of long, glassy hairs; margins with scattered long hairs to 6 mm. long; spikelets very densely arranged in 4 rows, the total width of the spikelets ca. twice the rachis width. Spikelets purple, 2.2-2.5 mm. long, obovate 1.4-1.5:1, blunt; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, 3-nerved, rather loose and somewhat wrinkled; upper (fertile) floret ca. as long as the spikelet; lemma stramineous, rigid, striate, strongly dorsally flattened; palea similar, flat; lodicules 2, truncate; anthers 3, purple, 1.5-1.6 mm. long; styles 2, separate; stigmas deep purple.

HOLOTYPE: Costa Rica: Prov. Cartago, 0.5 km. E of Planta Radiográfica, along railroad, 2 km. W of Paraíso, elevation 1,300 m., open grass marsh, 6 February 1969, *Pohl & Davidse 11699*, ISC. **ISOTYPES:** F, CR, US, K. **TOPOTYPE:** same location, 28 February 1969, *P. & D. 11742*. We collected this species in a marsh at the Planta Radiográfica near Paraíso. Previous collections were reported by Chase from Nuestro Amo and Aguacaliente. February to May. Guatemala, Honduras, Costa Rica.

This is the most striking of the Central American species of *Paspalum* because of its large size and very conspicuous inflorescences. The leaf margins are extremely scabrous and readily cut human skin. Our specimens are very consistent in appearance. The strongly keeled and overlapping basal sheaths are very distinctive, but may not be present on herbarium specimens. Chromosome number $n = 20$ from Costa Rican and Honduran collections. (Originally reported as *P. plenum*.) All meioses were very irregular, with univalents and multivalents present. It is very possible that this species, like many other in *Paspalum*, is apomictic. *Paspalum turritiforme* belongs to the informal group *Virgata* of Chase.

***Paspalum vaginatum* Swartz, Prodr. Veg. Ind. Occ. 21. 1788. Figure 154.**

Extensively rhizomatous and stoloniferous perennial; erect culm branches 2-50 cm. long; prostrate parts of the plants freely branching; erect culms simple or sometimes branching from the lower nodes and forming dense tufts; internodes 1-3 mm. thick, hollow, glabrous; lower internodes short, the upper ones successively longer; nodes glabrous, sometimes swollen, mostly concealed by the overlapping sheaths; leaves usually numerous; leaf sheaths loose, keeled, glabrous except for long silky hairs, up to 4 mm. long, on the short auricles; ligule a thin brown truncate membrane, 0.6-1.0 mm. long, adnate to the short sheath auricles; leaf blades 2-14 cm. long, mostly 1-4 mm. wide, conspicuously distichous, stiff, straight, ascending or spreading, involute, ridged and scabrid above, glabrous except for a few long marginal cilia. Peduncle exerted up to 4 cm.; inflorescences terminal on erect portions of the culms, 2-8 cm. long, usually composed of 2 conjugate diverging racemes, sometimes with 1-several more a short distance below; terminal racemes equal, naked at the base for up to 1 cm.; each raceme 2-8 cm. long, the spikelets borne in 2 rows, overlapping; rachis 1.0-1.5 mm. wide, flat, with a

prominent midrib, bearing a solitary spikelet on the tip. Spikelets 3.2-3.6 mm. long, obovate 2.2-2.6:1, acute, glabrous; strongly dorsally flattened; first glume absent in our material; second glume and lower (sterile) lemma equal, as long as the spikelet, mostly 5-nerved, or sometimes with the midnerve absent; lateral nerves paired, near the margins; sterile lemma lacking a palea; upper (fertile) lemma 2.5-3.2 mm. long, obovate, acute, whitish, finely striate; palea similar, flat; lodicules 2, truncate; anthers 3, purple, 1.8-2.0 mm. long; styles 2, separate; stigmas dark; caryopses not seen; most spikelets appear sterile.

Sandy or coral beaches of the ocean, salt marshes along the coast. Moín, Limón, Uvita, Río Banano, Cahuita, Playas del Coco, Coronado (Pte). June to December; probably blooming yearlong. North Carolina and southward; Baja California and southward on the Pacific Coast; southward to Peru and Argentina; West Indies; worldwide in warm coastal climates.

This species and *P. distichum* are rather similar and have often been confused. Chase gives an extensive synonymy. Recent discussions of the nomenclature of these species are reviewed under *P. distichum*. In addition to the spikelet and inflorescence differences given in the key, *P. vaginatum* often differs from *P. distichum* in its tendency to bear a large number of closely overlapping leaves, and in the production of dense tufts of culms. Our chromosome counts of Costa Rican *P. distichum* indicate $n = 30$. Literature accounts of the chromosome number of *P. vaginatum* list $n = 20$.

***Paspalum virgatum* L., Syst. Nat. ed. 10, 2:855. 1759. Figure 173.**



FIG. 173. *Paspalum virgatum*. Inflorescence, two views of a spikelet, fertile floret.

Tall, vigorous caespitose perennial; plants 80-250 cm. tall, erect; culms unbranched; internodes 3-8 mm. thick, hollow, glabrous; nodes shrunken, dark, glabrous; leaf sheaths somewhat keeled, overlapping, glabrous, or the overlapping margin, collar, and dewlap papillose-pilose; lower sheaths somewhat spongy, tessellate in drying; ligule a thin brown membrane, 1-3 mm. long, with a tuft of long white hairs behind it; leaf blades narrow-based, widest at the middle, flat; midrib wide, white, keeled beneath near the base; surfaces glabrous or rarely puberulent. Peduncles solitary, terminal, included or exerted up to 13 cm.; inflorescences 12-20 cm. long, of usually 8-13 ascending to drooping racemes; individual racemes 6-18 cm. long, the rachis 1.0-1.5 mm. wide, bearing a tuft of white hairs at its base; margins strongly scabrous and with scattered white hairs. Spikelets paired, 2.6-3.2 mm. long, blunt, obovate 1.2-1.6:1, mucronate, strongly dorsally flattened; first glume absent; second glume and lower (sterile) lemma equal, as long as the spikelet, 5-nerved, puberulent, the hairs longest at the summit; bracts purplish or reddish brown; upper (fertile) lemma nearly as long as the spikelet, light reddish brown or chestnut colored at maturity, striate; palea similar to the lemma, concave; lodicules 2, truncate; anthers 3, purple, 1.3-1.7 mm. long; styles 2, separate; stigmas purple; caryopsis 2.0-2.4 mm. long, broadly elliptical, reddish tan, opalescent. Chromosome number $n = 20$ from Costa Rican and Venezuelan specimens.

Moist pastures and roadsides, stream banks; occasional in Guanacaste and the General Valley, San Vito, Rincón, San José area, Río Sixaola near Bambú. Elevations mostly from sea level to 500 m. Blooming yearlong, but apparently most frequently during the rainy season. Southern Texas to Brazil; West Indies.

The length of the spikelets in our specimens is in the upper end of the range of sizes indicated by Chase, and some exceed it. The plants are striking by their large size and vigor. The only closely related species in our flora is *P. turriforme*, which does not have brown fertile florets.

PENNISETUM L. Richard

REFERENCE: Agnes Chase, The North American species of *Pennisetum*, Contr. U.S. Natl. Herb. 22:4:209-234 + X. 1921.

Perennial or annual caespitose, rhizomatous, or stoloniferous grasses; inflorescence a spike of bristly fascicles (much reduced in *P. clandestinum*), these deciduous from the rachis with the contained spikelets; spikelets 1-several per fascicle, usually sessile within it, remaining attached and falling with the bristles; bristles (sterile branchlets) usually numerous and conspicuous, antrorsely scabrous, often ciliate, mostly concealing the spikelets. Spikelets dorsally compressed; first glume much shorter than the spikelet, often obsolete, usually 1-nerved or nerveless; second glume usually shorter than the spikelet, several-nerved; lower floret sometimes sterile and lacking a palea, or with a well-developed palea and a staminate flower, the lemma usually 5-7-nerved; upper floret perfect-flowered, the lemma 3-5-nerved; palea well developed; lodicules present or absent; anthers 3; ovary with a single style and 2 stigmas, or the styles separate.

Pennisetum clandestinum is exceptional in its reduced inflorescence, abortive glumes, numerous nerves of the lemmas, and growth

habit. It may merit being placed in a separate genus. *Pennisetum* is closely related to *Cenchrus*, differing in the separate bristles of the fascicle, which are antrorsely scabrous. In *Cenchrus*, the bristles are more or less united into flat spines which are in almost all species retrorsely barbed. The basic chromosome number in most species of *Cenchrus* is $x = 17$, but various numbers excepting $x = 17$ have been found in species of *Pennisetum*. Although it is difficult to assign a few species of this complex definitely to one or the other of these genera, the generic characters hold for the great bulk of the species. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Pennisetum*

- 1a. Low creeping plants; inflorescences reduced to 1-several spikelets, concealed within sheaths, only their tips protruding, stigmas and stamens exserted; lemmas with 10-13 nerves *P. clandestinum*
- 1b. Erect plants with exserted terminal inflorescences composed of numerous bristly fascicles on elongated straight rachis; lemmas with 3-7 nerves 2
 - 2a. Spikelet 1 per fascicle 3
 - 2b. Spikelets several per fascicle 7
- 3a. Inflorescences solitary at tips of main culm or long leafy branches 4
- 3b. Inflorescences terminal and axillary, usually numerous on one culm and forming a compound inflorescence 6
 - 4a. Bristles of fascicle scabrous, not ciliate 5
 - 4b. Bristles of fascicle densely silky-ciliate near their bases, adjacent bristles becoming matted together by hairs *P. setosum*
- 5a. Lower lemma empty, lacking palea or staminate flower; spikelets acuminate or caudate; anthers purple, 1.2-1.5 mm. long; styles 2, separate ... *P. tempisqueense*
- 5b. Lower lemma with palea of equal length and staminate flower; spikelets acute; anthers orange, 3.0-3.6 mm. long; style single, bearing 2 stigmas *P. complanatum*
- 6a. Most bristles shorter than spikelet; lower floret sterile and lacking palea
P. distachyum
- 6b. Most bristles longer than spikelet; lower floret with well-developed palea and usually a staminate flower *P. bambusiforme*
- 7a. Tall stout plants, culms up to 8 m. tall, 1.0-2.5 cm. thick; spikelets stalked within fascicle *P. purpureum*
- 7b. Slender plants, culms less than 1.5 m. tall, 1-2 mm. thick; spikelets sessile in fascicle 7
 - 8a. Each fascicle with a single elongate inner bristle, 2-3 $\times$ as long as others; spikelets 6-9 mm. long *P. vulcanicum*
 - 8b. Inner bristle less than twice as long as others; spikelets 2-6 mm. long *P. ciliare*

***Pennisetum bambusiforme* (Fourn.) Hemsl. ex Jacks., Ind. Kew 2:458. 1895. *Gymnothrix bambusiformis* Fourn., Mex. Pl. 2:48. 1881. Figure 174.**

Tall vigorous perennial; the culms arising in clumps from decumbent and sometimes rooting bases, up to 1 cm. thick, hollow, glabrous; sheaths shorter than the internodes,

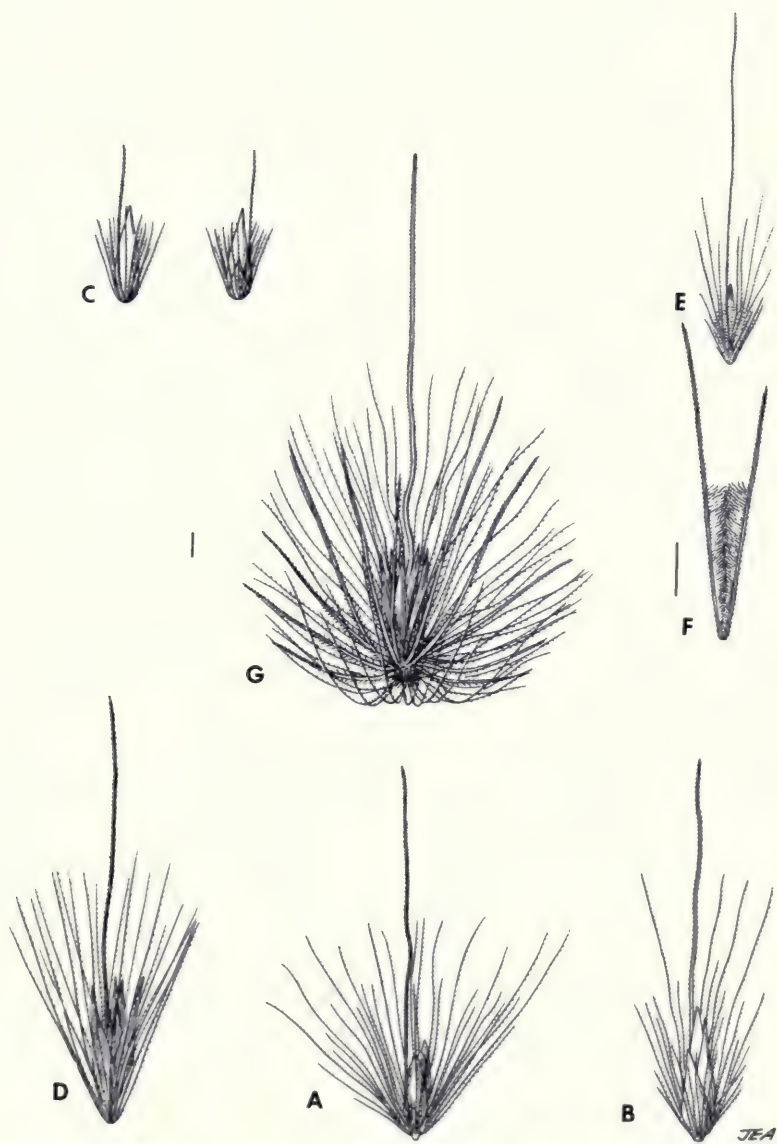


FIG. 174. *Pennisetum* species. *P. bambusiforme*: A, fascicle; *P. complanatum*: B, fascicle; *P. distachyum*: C, fascicles; *P. purpureum*: D, fascicle; *P. setosum*: E, fascicle; F, ciliate bristles; *P. vulcanicum*: G, fascicle.

glabrous or sometimes appressed-bearded just above the nodes and hirsute near the apex, papillose-ciliate on the upper margins and auricles; ligule 1-4 mm. long, a short membrane ciliate with a dense row of stiff erect hairs; larger leaf blades 20-32 cm. long, 20-40 mm. wide, more or less hirsute on both surfaces, flat, tapering to a petiole-like base. Inflorescence large and compound, of numerous spikes exerted on peduncles of varying lengths from the upper leaf sheaths, usually several from one axil, their subtending leaf blades usually much reduced or obsolete. Individual spikes drooping, usually purplish, cylindrical, loose, bristly, 6-10 cm. long, 1-2 cm. thick, including the bristles; individual fascicles borne on minute scabrous stipes; bristles numerous, scabrid, unequal, mostly 6-12 mm. long, surrounding a single spikelet; the uppermost bristle directly subtending the spikelet usually 16-18 mm. long, much longer than the others. Rachis of the spikes flexuous, angular, scabrous. Spikelets ovate, acuminate, 3.9-5.2 mm. long, sessile in the fascicle and falling with it; first glume minute, obtuse, 1-nerved; second glume broadly ovate, caudate, 1-nerved, 1-2 mm. long; lower lemma longer than the upper, 4.0-5.2 mm. long, ovate, caudate, faintly 5-6-nerved, scabrid, enclosing a 2-nerved palea ca. two-thirds as long; 3 stamens usually present; upper floret perfect-flowered, the lemma ovate, caudate, 3.0-4.2 mm. long, faintly 3-5-nerved, chartaceous, scabrid, the palea shorter; lodicules 2, truncate; style branches 2, naked below; stigmas brown; anthers 3, 1.5-2.0 mm. long. Chromosome number $n = 18$ from a Costa Rican specimen.

Meseta Central and Cordillera de Talamanca; elevations from 950 to 2,600 m. This species is a conspicuous part of the vegetation of steep slopes, where it arches over other plants, the large purplish compound inflorescences drooping. Blooming July to March, possibly yearlong. Southern Mexico to northern South America.

***Pennisetum ciliare* (L.) Link, Hort. Berol. 1:213. 1827. *Cenchrus ciliaris* L., Mant. 302. 1771. *Pennisetum cenchroides* L. Rich. ex Pers., Syn. Pl. 72. 1805.**

Perennial from hard, knotty crowns, sometimes with short rhizomes; culms 25-100 cm. long, erect, 1-2 mm. thick, solid or hollow, sometimes much branched from basal, lower, and middle nodes and becoming bushy; leaf sheaths about equal to the internodes, glabrous or sparsely pilose, keeled; ligule a densely ciliate membrane, 0.5-2.5 mm. long; blades 3-24 cm. long, 2-9 mm. wide, scabrous, sometimes slightly pilose, tapering to a caudate apex. Peduncle exerted; inflorescences terminal on leafy branches; inflorescence a densely cylindrical spike of bristly fascicles, 2-12 cm. long, 1-2.5 cm. wide; rachis internodes 0.8-1.0 (2.0) mm. long; fascicles concealing the rachis, often purplish, 6-15 mm. long, including the bristles, 1.5-3.5 mm. wide; stipe of fascicles pilose, 0.5-1.5 mm. long; bristles erect to spreading, flexuous, 4-10 mm. long, 0.2-0.6 mm. wide, conspicuously ciliate, antrorsely scabrous, very slightly united at the base. Spikelets 2-4 per fascicle, 2.0-6.0 mm. long, dorsally compressed; first glume 1.0-3.0 mm. long, 1-nerved, thin and membranaceous; second glume 1.3-3.4 mm. long, 1-3-nerved; lower lemma 2.5-5.0 mm. long, 5-6-nerved, the palea 2.5-5.0 mm. long, enclosing a staminate flower; upper lemma 2.2-5.4 mm. long, thin, 5-nerved.

This species has been cultivated in the grass garden of the IICA at Turrialba, but has not as yet appeared in cultivation elsewhere in Costa Rica. It has considerable forage potential and is much cultivated

in warm climates. This species lies close to the indeterminate boundary line between *Pennisetum* and *Cenchrus*. Because of the hard-based perennial growth habit, lack of flattened, retrorsely-barbed spines, the basic chromosome number of $x = 9$, and the extensive occurrence of apomixis, it seems more closely allied to *Pennisetum* than to *Cenchrus*. Native from Africa to India. Common name: *Zacate buffel*, "Buffel grass."

***Pennisetum clandestinum* Hochst. ex Chiov. in Annuario Reale Ist. Bot. Roma 8:41, t. v., fig. 2. 1903. Figure 175.**

Vigorous low creeping perennial; erect branches up to 45 cm. when not grazed, usually 15 cm. or less tall; rhizomes and stolons present; internodes very short and densely clothed with overlapping sheaths; branching profuse, erect branches being produced at most nodes; prophylla prominent, retrorsely scabrous on the keels; sheaths keeled, glabrous or usually papillose-hirsute, especially on the upper margins; ligule a dense ciliate rim, up to 2 mm. long; blades folded or flat, 3-9 cm. long, 2-5 mm. wide, the tip blunt and sometimes slightly bifid; upper and lower surfaces glabrous or with scattered long hairs. Inflorescence a short mostly concealed axillary spike, the 1-4 spikelets sessile and solitary at the nodes of a short flattened rachis, only their tips exerted from the leaf sheaths. Spikelets not disarticulating from the plant, each surrounded by a basal fascicle of slender bristles of varying lengths, mostly less than half the length of the spikelet; shape of spikelet narrowly lanceolate, tapering to a slender apex; first glume absent, the second absent or reduced to a minute nerveless scale; lower and upper lemmas equal, similar, 19-22 mm. long; lower lemma empty and without a palea, 10-13-nerved; upper lemma 10-12-nerved, its palea 2-7-nerved, 16-17 mm. long; lodicules none; flower usually hermaphrodite, protogynous, the short-plumose solitary style up to 3 cm. long, exerted through the tip of the floret, stigmatic on its exposed parts; anthers 4-7 mm. long, at anthesis exerted from the floret on stiff, erect, white filaments up to 3 cm. long, the anthers dangling at their tips. Caryopses not seen.

This is one of the most abundant and widely distributed forage grasses in upland pastures, from 1,500 to 2,500 m. elevation. It is readily recognized by its creeping stems and light green color. Under certain circumstances it becomes an invading weed on cultivated ground. It is native to tropical Africa, but is cultivated in many parts of the world. In the Americas, it occurs in California, Guatemala, Costa Rica, and various South American countries.

Most reproduction in this species appears to be by the stolons, but production of seed, which may be dispersed in the manure of grazing animals, has been reported from South America. The erect stamens, unique in this species, are often exerted during the mornings in very humid weather. Unlike most other grasses, there is but a single stigma. Both stamens and stigma are exerted from the tip of the fertile floret, because of the lack of lodicules. Many florets with exerted stigmas show anthers still concealed within the floret, and it is



FIG. 175. *Pennisetum clandestinum*. A, growth habit; B, fascicle with a spikelet; C, emergent stamens.

possible that they do not emerge. Common names are *Kikuyo*, *Pasto Kikuyo*, *Pasto africano*.

Pennisetum complanatum (Nees) Hemsl., Biol. Centr. Amer. Bot. 3:507. 1885. *Gymnothrix complanata* Nees, Bonplandia 3:83. 1855. *G. mexicana* Fourn., Mex. Pl. 2:48. 1881. *G. grisebachiana* Fourn., Mex. Pl. 2:48. 1881. Figure 174.

Perennial, rhizomatous, 75-200 cm. tall, or much shorter when grazed; culms branched from the lower and middle nodes, often decumbent and rooting, 2-3 mm. thick, glabrous, hollow, thick-walled; nodes glabrous or slightly appressed-hispid; sheaths longer than the internodes, loose, somewhat compressed, glabrous or ciliate on the upper margins; ligule 1.0-1.6 mm. long, a minute membrane crowned with a dense row of stiff white hairs; blades 15-55 cm. long, flat or folded, 3-7 mm. wide, attenuate, scabrous, the upper surface hirsute near the base. Peduncles exserted; inflorescence a dense cylindrical spike of bristly fascicles, terminal on the main culm or on leafy branches, 8-17 cm. long, 7-10 mm. thick without the bristles, 10-25 mm. including them, tawny or purplish; spikelets borne singly in the sessile fascicles on the angled scabrous rachis. Bristles of the fascicle numerous, stiff, scabrous; outer bristles 1-5 mm. long, the inner 8-12, one single inner bristle much longer, 10-19 mm. long; fascicle deciduous with the solitary contained spikelet. Spikelets narrowly ovate, acute, dorsally compressed, 5-6 mm. long; first glume rotund or ovate, nerveless or with a single weak nerve; second glume shorter than the spikelet, 3.8-4.6 mm. long, 5-nerved, ovate, acute; lower lemma 4.4-5.7 mm. long, ovate, 5-nerved, its palea equal; anthers 3, orange, 2.4-3.2 mm. long; upper floret 4.5-5.7 mm. long, chartaceous, the lemma ovate, acute, faintly 5-nerved, its palea equal to the lemma; lodicules absent; anthers 3, orange, 3.0-3.6 mm. long; style single, dividing into 2 plumose short stigmas.

Known from Costa Rica only about the hot springs of Las Hornillas, west face of Volcán Rincón de la Vieja, elevation 750 m. Southern Mexico to El Salvador; Costa Rica and Panama.

Pennisetum distachyum Ruprecht, Bull. Acad. Roy. Sci. Bruxelles 9:2:242. 1842. *Gymnothrix distachya* (Rupr.) Fourn., Mex. Pl. 2:48. 1881. Figure 174.

Tall vigorous perennial; culms arching, 2.5-3 m. long, in clumps from hard, knotty corklike bases, the lower nodes rooting; internodes 3-6 mm. thick, glabrous; nodes appressed-hispid; sheaths mostly shorter than the internodes, glabrous except for the ciliate upper margins; ligule 1.5-3.5 mm. long, a short stiff membrane densely ciliate with stiff erect white hairs; larger leaf blades 17-45 cm. long, 15-35 mm. wide, flat, tapering to a narrow petiole-like base, glabrous to hirsute on both surfaces, the margins scabrous. Inflorescence of numerous terminal and axillary spikes, these borne on slender peduncles, usually several of unequal length from a single leaf axil; ultimate leaf blades of the flowering branches much reduced. Individual spikes 3-10 cm. long, 7-10 mm. thick, greenish or purplish; rachis slender, scabrous, flexuous, the minute scabrous stipes of the fascicles persisting on the rachis after they disarticulate. Fascicles each with a single spikelet, the bristles not conspicuous, mostly shorter than the spikelet except the innermost, which may be up to 20 mm. long. Spikelets narrowly ovate, acute to acuminate,

dorsally compressed, 4.0-6.2 mm. long, remaining attached to the fascicle; first glume minute, 0.5-1.2 mm. long, oblong-lanceolate, 1-nerved or nerveless; second glume ovate, acute, faintly 3-nerved, 1.8-2.5 mm. long; lower lemma 4.8-5.4 mm. long, narrowly ovate, acute or acuminate, scabrid toward the tip, faintly 5-nerved, the midnerve sometimes suppressed; no palea or flower present; upper lemma 3.8-5.4 mm. long, similar to the lower, chartaceous, faintly 3-5-nerved, the margins thin and overlapping the edges of the palea, which is 3.7-4.7 mm. long; lodicules 2, truncate; anthers 3, purple, 1.3-1.8 mm. long; styles naked at the base; stigmas 2, brown to purple. Chromosome number $n = 18$ from a Costa Rican specimen.

Open, disturbed areas around San José, southern slopes of Volcán Turrialba, San Ramón. February to November, probably yearlong. Southern Mexico and Guatemala, Costa Rica.

The nomenclature of this species is confused and citations of authors are often incorrect. Since *P. distachyum* was originally described by Ruprecht in 1842, Fournier (1881) cannot be cited parenthetically. Mrs. Chase believed the name should be applied to the species above, having short bristles. Her usage is followed. The type specimen (*Galeotti 5680*) was not seen by Chase, but was cited by Fournier, when he transferred the species to the genus *Gymnothrix* in 1881. Since descriptions are obscure and may refer to several species, definite application of the name awaits the examination of the specimen.

***Pennisetum purpureum* Schum., Beskr. Guin. Pl. 64. 1827. Figure 174.**

Tall stout perennial, forming large clumps; culms erect, to 8 m. tall, 1.0-2.5 cm. thick, solid or hollow, the bases often decumbent and rooting; branching sparse, mostly from the lower nodes; culms usually glabrous, glaucous, or sometimes pubescent near the summit; nodes not prominent, glabrous or sometimes appressed-hispid; sheaths glabrous or sometimes papillose-hirsute; ligule a minute membrane, bearing a dense row of long, stiff white hairs, in total 1.5-3.5 mm. long; leaf blades up to 125 cm. long and 4 cm. wide, glabrous to papillose-pubescent; midrib prominent beneath; margins strongly scabrous. Inflorescence a dense cylindrical spike of bristly fascicles, up to 30 cm. long, 1-2 cm. thick excluding the longer bristles; color golden yellow to purple; rachis cylindrical, densely clothed with white hairs, bearing the stubs of the stipes of the fascicles. Fascicles bearded at the base with short white hairs; bristles numerous, usually golden, scabrous, of varying lengths up to 10-15 mm. long; innermost bristle thicker, up to 40 mm. long, usually twice as long as the others; spikelets 1-5 per fascicle, the larger ones on minute pedicels above the bristles, the smaller or abortive ones on longer pedicels to 2 mm. Spikelets 4.5-7.0 mm. long, (except the abortive ones), dorsally compressed, narrowly ovate, caudate; remaining attached and falling with the fascicle; first glume absent or a minute rounded scale up to 0.7 mm. long; second glume ovate, 1-nerved, 1.5-2.6 mm. long; lower lemma 4.0-5.2 mm. long, narrowly ovate, acuminate, 3-nerved, the nerves scabrid; staminate flower of 3 stamens usually present; palea about equal to the lemma; upper floret 4.6-7.0 mm. long, the lemma shiny, the 5-7 nerves scabrid; palea about equal to the lemma; lodicules lacking; anthers 3, 2.7-3.6 mm. long; style 1, its upper part and the 2 stigmas plumose.

Cultivated as a forage grass at low and medium altitudes up to 1,800 m. and escaping on river banks and in open areas. Blooming July to November, probably yearlong. Native to tropical Africa, but widely cultivated in tropical regions of the world. Florida and the West Indies; Guatemala; Costa Rica, to Brazil. The earliest specimen from Costa Rica was collected in 1924. An extensive synonymy is given by Stapf and Hubbard in Fl. Trop. Africa 9:1017-1018 (1934). Common names: *Yerba elefante*, *Elefante*, *Gigante*.

Pennisetum setosum (Swartz) L. Rich., in Pers. Syn. Pl. 1:72. 1805. *Cenchrus setosus* Swartz, Prodr. Veg. Ind. Occ. 26. 1788. Figure 174.

Vigorous perennial; culms 1-2 m. long, in clumps from hard, knotty cormose bases, bases sometimes decumbent, arching, branching from middle and upper nodes, 3-5 mm. thick, hollow, glabrous; leaf sheaths usually shorter than the internodes, glabrous or pilose along the upper margins, one side with a vertical auricle; ligule a short stiff membrane, densely ciliate with a row of long, stiff hairs, total length 1.5-2.7 mm.; sometimes a row of minute bristles on the collar; leaf blades acuminate, the larger ones 15-55 cm. long, 4-18 mm. wide, mostly glabrous beneath, scabrid on margins and upper surface, with long, papillose-based stiff hairs on upper surface near the base, sometimes hirsute on both surfaces. Peduncles exerted on the main culm or on leafy branches, glabrous; inflorescences purplish, arching, 10-25 cm. long, 6-10 mm. thick excluding the bristles, 15-30 mm. including them; fascicles and bristles ascending in nature, often reflexed in herbarium specimens; fascicles densely crowded, sessile on the thin cylindrical, notched and grooved rachis; bristles of several unequal series, the outer ones very short, thin and delicate, the inner flattened and rigid near the base, conspicuously ciliate with delicate silky hairs about to the tip of the spikelet, the hairs of adjacent bristles becoming interlaced and tangled; inner bristles 6-12 mm. long, except the innermost one which is usually 16-22 mm. long, much exceeding the spikelet; fascicles with their included spikelets freely deciduous from the rachis. Spikelets one per fascicle, ovate, acute, 3.7-4.5 mm. long, sessile, remaining attached to the fascicle; first glume obsolete or up to 1 mm. long, oblong, nerveless; second glume 3.7-4.5 mm. long, 5-7-nerved, ovate, the tip 3-lobed; lower lemma 3.0-3.9 mm. long, ovate, 5-7-nerved, the tip lobed, the palea shorter; anthers 3 or 0; upper floret readily deciduous from the spikelet, perfect-flowered; lemma chartaceous, smooth and shining, ovate, acute, 2.2-3.0 mm. long, its flat margins covering the edges of the palea; anthers 3, yellow, 1.7-2.1 mm. long; lodicules absent; styles 2, naked below; caryopsis elliptical, ca. 1.7 mm. long. Chromosome number $2n = 53$ from a Costa Rican specimen.

Steep hillsides and road cuts, hilly savannas; western parts of the Meseta Central, San Mateo, San Ramón, Nicoya Peninsula, Cañas, Boruca, Monteverde. Elevations 100-1,500 m. Blooming from late October to February. Southern Florida; southern Mexico to Brazil; West Indies.

Many cytological abnormalities were observed, indicating possible apomixis.

***Pennisetum tempisque* Pohl, Fieldiana, Bot. 38:6. 1976. Figure 176.**

Caespitose perennial; plants 39-100 cm. tall; culms erect, unbranched, densely clustered, glabrous, glaucous, rather thin-walled, the interior filled with parenchyma; nodes glabrous, constricted, dark; leaves ca. 7 per culm; sheaths mostly shorter than the internodes, compressed and keeled, glabrous and glaucous, the margin thin and membranaceous; ligule a short membrane, densely long-ciliate, 1.0-1.8 mm. long; leaf blades flat or folded, keeled near the base, firm, scabrous-margined, the base narrower than the summit of the sheath, glabrous and glaucous, 4.5-7.5 mm. wide, 8-22 cm. long, the uppermost shorter. Peduncle exserted; inflorescence a solitary terminal spike of fascicles, stiff and erect, whitish, 7-10 cm. long, 2.0-2.5 cm. thick, including the bristles; rachis ca. 1 mm. thick, longitudinally striate, densely short-hispid; fascicles borne on minute projections of the rachis, crowded, horizontally spreading, mostly 10-14 mm. long; bristles ca. 20 per fascicle, whitish, of varying lengths, the outermost 3-4 mm. long, the majority 8-10 mm. long, the innermost one longer and thicker, 12-17 mm. long, all straight, upwardly scabrous, attached to a short, rounded common stipe ca. 0.2-0.3 mm. long. Spikelet one per fascicle and sessile within it, narrowly ovate, acuminate, 5-6 mm. long; first glume ovate, 1.0-1.5 mm. long, acute to rounded, scarcely nerved, membranaceous; second glume, lower lemma, and upper lemma subequal, acuminate or awn-tipped; second glume 5.0-5.5 mm. long, striate, 7-nerved; lower lemma 5.7-5.9 mm. long, 5-nerved, without a palea or flower; upper lemma 5.2-5.7 mm. long, faintly 5-nerved, the palea about equal, 2-nerved, acuminate; anthers purple, 1.2-1.5 mm. long; ovary with 2 separate styles; stigmas purple; caryopsis oblong, tan, 2.1-2.2 mm. long.

Known only from the type specimen, collected on a black gumbo clay flat, 8 km. N of Hacienda Palo Verde, Guanacaste, elevation 10 m., *Pohl & Davidse 11725*. The plants were past maturity when collected in late February. Chromosome number $n = 36$, originally published as *P. nervosum* in Pohl & Davidse, 1971.

This species differs from the widespread *P. complanatum* (Nees) Hemsl. in its caespitose rather than rhizomatous character, in the fewer, more slender whitish bristles, the acuminate spikelets with sterile lower floret, and the separate styles. It differs from the South American *P. nervosum* in its smaller size, solid culms, smaller inflorescences, fewer bristles, shorter spikelets with short first glume, and its chromosome number ($n = 36$, that of *P. nervosum* being $n = 18$). It appears similar to *P. frutescens* Leake of southern South America, from which it differs in its solid culms, longer bristles, smaller size, lack of rhizomes, and different chromosome number. *Pennisetum frutescens* has $2n = 63$ (Nuñez, 1952). The specific name is derived from the Río Tempisque, near the type locality.

***Pennisetum vulcanicum* Chase, J. Wash. Acad. Sci. 13:363. 1923. Figure 174.**

Perennial, 1.0-1.5 m. tall, erect, the culms somewhat branched, glabrous; sheaths keeled, longer than the internodes, glabrous to papillose-pilose; leaf blades 20-45 cm.



FIG. 176. *Pennisetum tempisqueense*. A, inflorescence; B, growth habit; C, fascicle, D, pistil.

long, 5-8 mm. wide, attenuate, papillose-pilose above. Inflorescence 10-17 cm. long, linear, cylindrical, 5-12 mm. thick, not including the bristles, up to 45 mm. including the longer bristles; fascicles crowded, sessile; rachis visible; spikelets 3-5 per fascicle, sessile; outer bristles short and fine, 3-4 mm. long; second series of bristles 10-12 mm. long, scabrous; inner series much fewer, thick and stiff, prominently long-ciliate on their lower halves; innermost bristle flattened, ca. twice as thick as the others and much longer, to 2-5 cm. long; stipe short, hairy. Spikelets 6-9 mm. long, dorsally compressed; first glume ovate, apiculate, 1-nerved, 2.7 mm. long; second glume ovate, acute or blunt, 2-4-nerved, 3.0-3.5 mm. long; lower lemma 5.2 mm. long, ovate, 5-nerved, its palea 4.5 mm. long; anthers 3; upper lemma 5.7 mm. long, narrowly ovate, acuminate, 5-nerved, its palea 4.5 mm. long; anthers 3, orange, 2.7-3.0 mm. long; styles 2, separate, long and slender, naked below.

This species is rare and little known. One specimen named by Agnes Chase (*Garnier 822*, from Managua, Nicaragua) had shriveled, non-opening anthers and collapsed pollen. Southwestern Mexico, Guatemala, El Salvador, Nicaragua. The only Costa Rican specimen determined by Chase was from Nuestro Amo (*O. Jiménez 522*). This species is closely related to *P. karwinskyi* Schrad., which has been transferred by DeLisle to *Cenchrus* as *C. multiflorus* Presl. By growth habit and fascicle structure, it seems more closely related to *Pennisetum*.

PENTARRAPHIS Humboldt, Bonpland, and Kunth

Tufted small annual or perennial grasses; spikelets borne in fascicles on a slender erect flattened rachis and dropping from it whole; fascicle consisting of 1-2 spikelets, the lower sometimes reduced to a group of 2-4 stiff bristles; spikelets 2-flowered; first glume acicular, resembling the sterile bristles, the second subulate; lower floret perfect-flowered, its lemma 3-lobed; marginal lobes awnlike, arising about the middle of the length of the lemma; central lobe bifid, the 2 acuminate teeth arising at the base of the awn; nerves 3, all near the center of the lemma; second floret similar to the first but smaller, its flower abortive.

Species 3, in Mexico, Central America, and Colombia. The genus is closely related to *Bouteloua*. (Choridoideae: Chlorideae.)

Pentarraphis annua Swallen, Ceiba 4:286. 1955. Figure 177.

Tufted annual; plants 10-25 cm. tall, the culms erect, in small tufts, branching from the base and lower nodes, glabrous, hollow, ca. 0.3 mm. thick; nodes enlarged, glabrous; prophylla 7-14 mm. long, exceeding the sheaths; sheaths glabrous, much shorter than the internodes; ligule ca. 0.3 mm. long, a minute ciliate fringe; blades 1-4 cm. long, ca. 1 mm. wide, mostly involute, bearing a few scattered long hairs on the auricles and upper surface. Inflorescences terminal and axillary, the axillary ones of 1-2 partly concealed spikelets, the terminal inflorescence a slender spike, 2-3 cm. long, the rachis flattened, scabrous, terminating in a forked bristle-like rudiment; spikelet fascicles less than 10; fascicles consisting of a single fertile spikelet, subtended by several hispid bristles (rudimentary sterile spikelets), ca. 2.5 mm. long, the whole disarticulating from the rachis as a group with a bearded callus. Spikelets 8-9 mm. long, including the awns; first



FIG. 177. *Pentarraphis annua*. A, inflorescence; B, apex of rachis with two appendages and a spikelet fascicle; C, spikelet fascicle; D, lemma.

glume bristle-like, similar to the sterile bristles, hispid on its upper half, 2.0-2.5 mm. long; second glume subulate, 3.5-4.0 mm. long, tapering into a stiff scabrous awn; lower floret perfect-flowered, its callus bearded; lemma 3.2-3.5 mm. long, strongly 3-lobed; lateral nerves close to the midrib and extending into the acuminate teeth of the lemma; awn arising between the teeth, 4-5 mm. long, stiff and scabrous; back of the lemma bearing a transverse band of appressed-hispid hairs near the middle; margins of lemma produced into 2 stiff acuminate awnlike lobes, 4-5 mm. long, attached ca. one-third below the apex; palea 3.0-3.3 mm. long, bifid at the tip; anthers 3, purplish, 0.7-0.8 mm. long; caryopsis narrowly elliptical, free, 1.3 mm. long, tan; second floret similar to the first but smaller, its lemma 2.5-3.0 mm. long, glabrous, the flower apparently abortive.

Rare; Hacienda Las Animas, Guanacaste. Our only specimen was collected from a dry tuff outcrop. December. Originally described from Honduras; Panamá and Colombia.

PEREILEMA Presl

Short-lived annual grasses, developing at the beginning of the dry season; plants tufted, erect or the culms decumbent and rooting at the base, with erect flowering branches arising from the rooting nodes. Inflorescence a dense, lobed cylindrical panicle. Spikelets borne in dense fascicles crowded on the short erect branches; fascicles of several functional spikelets, with an involucre of reduced sterile spikelets, mostly in the form of short scabrid awns; spikelets 1-flowered; glumes equal, 1-nerved, awned from a bifid apex; floret disarticulating from the persistent glumes; lemma terete, long-awned; callus bearing straight erect hairs; palea about as long as the lemma.

The genus appears close to *Muhlenbergia*, differing in the fascicle of sterile branchlets. (Chloridoideae: Sporoboleae.)

KEY TO SPECIES OF *Pereilema*

- 1a. Upper leaf blades 5-8 mm. wide; awns straight; anthers 2, purple, 0.7-1.0 mm. long *P. beyrichianum*
- 1b. Upper leaf blades 2-3 mm. wide; awns flexuous; anthers 3, yellow, 0.5 mm. long *P. crinitum*

***Pereilema beyrichianum* (Kunth) Hitchc., Contr. U.S. Natl. Herb. 24:385. 1927. *Muhlenbergia beyrichiana* Kunth, Enum. Pl. 1:200. 1833.**

Tufted annual; culms sometimes decumbent and rooting from lower nodes, 40-80 cm. long, mostly simple, 1-2 mm. thick, hollow, slightly scabrid-roughened, often reddish; nodes glabrous, not prominent; prophylls prominent, 2-3 cm. long, 2-toothed; leaf sheaths shorter than the internodes, minutely scabrid; ligule a thick brown membrane, 0.7-1.0 mm. long; leaf blades 10-20 cm. long, 5-8 mm. wide, scabrid; auricles prominent, embracing the stem, ciliate. Peduncle mostly included, or exserted to 6 cm.; rachis of panicle angular, upwardly ciliate-scabrous; panicle single, terminal on the culms or on leafy branches arising from rooted lower nodes, 10-20 cm. long, 1-2 cm. wide, cylindrical, lobulate near the base; branches solitary, short, 1-3 cm. long, erect and appressed to the rachis, densely covered with fascicles of spikelets; fascicles dense. Functional spikelets terete; glumes subequal, 0.7-1.0 mm. long, oblong to broadly ovate, bearing an awn 3-4

mm. long; lemma 1.0-1.5 mm. long, 3-nerved, lanceolate, tapering into a straight awn up to 2 cm. long; palea equal to lemma, tapering into a short awn tip; anthers 2, 0.7-1.0 mm. long, purple; sheaths and awn often reddish; awns bearing chloridoid microhairs. Chromosome number $n = 40$, from a Costa Rican specimen.

Occasional in the Meseta Central near San José; Guadalupe, Río Tiliri, Llano Grande, Puente Mulas; also near Santa Maria de Dota; brushy slopes; elevations 800-1,800 m. Late November to February. Guatemala and Costa Rica to northern South America.

***Pereilema crinitum* Presl, Rel. Haenk. 1:233. 1830. Figure 178.**

Tufted annual, the culms sometimes decumbent and rooting at the lower nodes and bearing upright flowering branches from the rooted nodes; prophylls prominent, 2-5 cm. long, the keels bearing awns 2-4 mm. long at the tip; keels ciliate; culms 1 mm. thick, hollow, glabrous; nodes glabrous; sheaths mostly overlapping, scabrid; ligule 0.3-0.5 mm. long, a minute lacerate membrane; leaf blades 5-15 cm. long, 2-3 mm. wide, glabrous, tapering to a narrow base; auricles prominent, embracing the stem, ciliate. Peduncle ridged, angular, scabrid, included or exerted up to 5-10 cm.; panicles single, terminal, narrowly cylindrical, lobulate below, 5-13 cm. long, 2-3 cm. wide, including the awns; branches solitary, erect, ca. 1 cm. long, the lowermost often remote; spikelets borne in densely crowded fascicles; sterile bristles ca. 3 mm. long. Glumes of functional spikelets subequal, 1 mm. long, 1-nerved, oblong to ovate, bifid at the summit, with an awn ca. 2 mm. long; lemma 1.5 mm. long, lanceolate, 3-nerved, the lateral nerves marginal; callus hairs dense, erect, one-third to one-half as long as the lemma; lemma scabrid, tapering into a reddish, undulate awn 2-3 cm. long; palea equal to lemma; anthers 3, 0.5-0.7 mm. long, yellow. Chromosome number $n = 10$ from Costa Rican material.

Scattered in the Meseta Central and a few other localities; Boruca, San Isidro de El General, Valley of Río Grande de Tarcoles; mostly on steep exposed slopes, savannas, or road cuts; elevation 500-1,500 m. Guatemala and Honduras; Costa Rica to Ecuador.

This species, like the preceding, develops very rapidly from seed at the beginning of the dry season and soon goes to seed and dies. November and December, rarely to February.

PHALARIS Linnaeus

Plants annual or perennial, caespitose or rhizomatous; inflorescence a dense cylindrical or ovoid terminal panicle; spikelets laterally compressed, the glumes equal, keeled, longer than and concealing the florets; florets 2 or 3, the lower 2 greatly reduced, appearing as little scales attached to the base of the fertile floret and disarticulating with it; fertile floret laterally compressed, rigid and shiny, awnless, glabrous or appressed-hairy.

A genus of about 15 species of annual and perennial grasses, mostly native to the North Temperate Zone, with a few in southern South America. The genus belongs to the Pooideae subfamily, and is probably



FIG. 178. *Pereilema crinitum*. A, inflorescence; B, fascicle of spikelets; C, glumes and floret.

most closely related to *Hierochloë*, from which it differs in its reduced lower florets. (Pooideae: Phalarideae.)

KEY TO SPECIES OF *Phalaris*

- 1a. Rhizomatous perennial; leaves longitudinally green and white striped; inflorescences not produced under Costa Rican conditions *P. arundinacea*, f. *picta*
- 1b. Caespitose annuals; leaves green; inflorescences produced 2
- 2a. Sterile lemmas 2, more than half as long as fertile floret *P. canariensis*
- 2b. Sterile lemma 1, less than half as long as fertile floret *P. minor*

***Phalaris arundinacea* L., Sp. Pl. 55. 1753, f. *picta* (L.) Aschers. and Graebn., Syn. Mitteleurop. Fl. 24. 1898.**

This is a sterile form of the common reed canary grass of the north temperate zone. It is widely cultivated as an ornamental in cooler climates. We have seen it cultivated in Los Yoses, but without inflorescences.

***Phalaris canariensis* L., Sp. Pl. 54. 1753. Figure 179.**

Tufted annual; culms erect, 30-100 cm. tall; panicle ovoid, 1.5-4 cm. long, up to 2 cm. wide, dense; spikelets broad, with a strongly winged keel; glumes 7-10 mm. long, with alternating whitish and green longitudinal stripes; fertile floret acute, 4.8-6.8 mm. long, densely appressed-pubescent; sterile florets 2, 2.5-4.5 mm. long, 1.4-1.7 mm. wide, sparsely pubescent.

This species produces one of the types of "seeds" commonly fed to caged birds. For this reason, the plants may appear on waste heaps almost anywhere. Our single collection from Costa Rica was from a gutter along Avenida Central near La Luz, San José.

***Phalaris minor* Retz., Fasc. Obs. Bot. 3:8. 1783.**

Caespitose annual; culms 20-100 cm. tall; panicle ovate-oblong, 1-6 cm. long, 1-2 cm. thick; glumes subequal, 4.0-6.5 mm. long, strongly keeled, and winged near the tip; fertile lemma 2.7-4.0 mm. long, 1.2-1.8 mm. wide, ovate, with a beaklike apex, yellow to gray-brown, shiny, appressed-pubescent; sterile floret one, usually 1.0-1.8 mm. long, appressed to the fertile floret, rarely very reduced and only 0.2-0.3 mm. long.

A single specimen, probably of this species, was collected from a corn field near Potrero Cerrado, Prov. of Cartago, at 2,300 m. elevation. The specimen lacks the basal portions and cannot be separated with complete certainty from *P. aquatica* L., a bulbous-based or rhizomatous perennial. Introduced from the Old World. Common name: *Pasto San Juan*.

PHARUS Linnaeus

REFERENCE: A. Prodoehl, *Oryzae monographice describuntur*, Bot. Arch. 1:*Pharus* X:247-252. 1922.

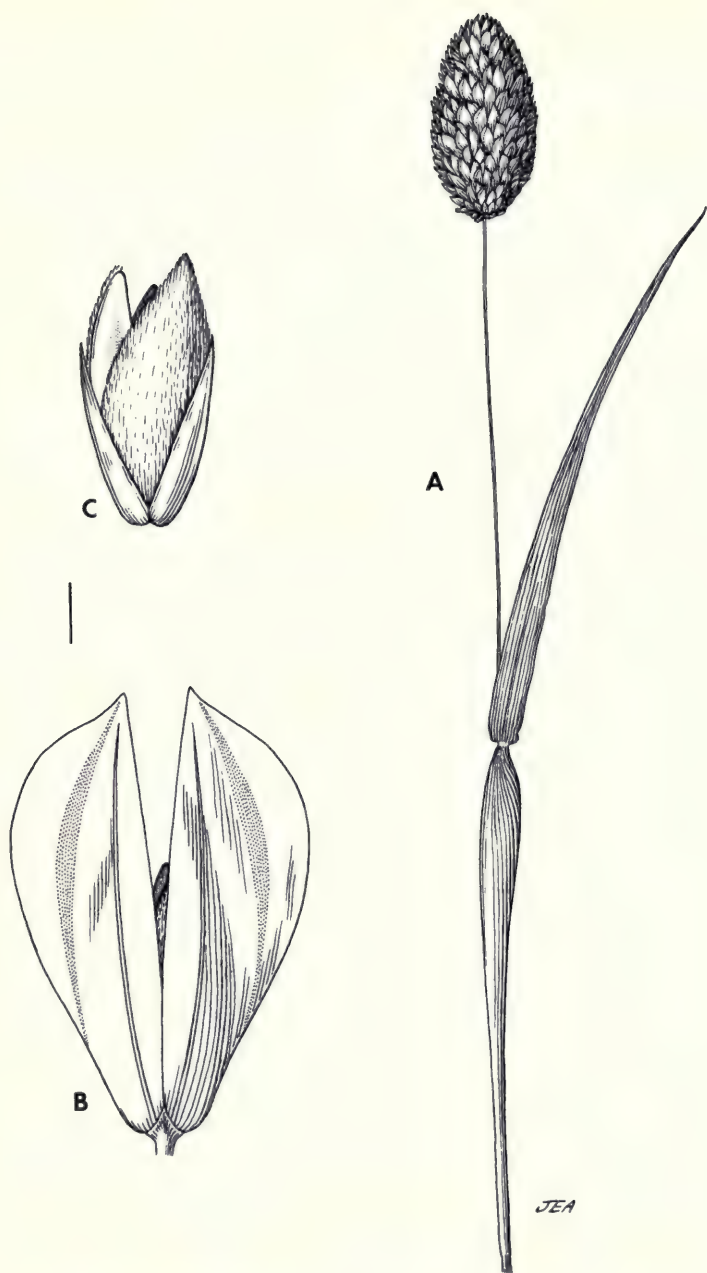


FIG. 179. *Phalaris canariensis*. A, blooming culm; B, spikelet; C, two lower sterile lemmas and terminal fertile floret.

Caespitose or trailing perennial herbs; leaf blades large, borne on conspicuous pseudopetioles, lanceolate, elliptical, or obovate, inverted in position, the pseudopetiole having a 180-degree twist; veins diverging from the midrib and running straight to the margins of the blade; commissural veins conspicuous, the blades tessellate. Inflorescence a solitary terminal panicle, the rachis usually terminating as a thin sterile bristle, rarely tipped with a single spikelet. Spikelets unisexual, borne in pairs, the larger pistillate member of each pair sessile, the small pedicellate staminate spikelet appressed to it, its pedicel arising at the base of the pistillate spikelet. Pistillate spikelets with 2 subequal usually many-nerved glumes, shorter than the floret; floret 1, readily disarticulating above the glumes when mature; lemma cylindrical, straight or sigmoid, coriaceous, the margins inrolled over an equal linear palea, lemma terminating in a short conical beak; back of the lemma near the tip beset with uncinat hairs, these continuing to base of the lemma in some species; nerves 7, not conspicuous except at the contracted base; style 1, stigmas 3, hispid; caryopsis oblong, grooved on the palea side, ends blunt; embryo small, basal. Staminate spikelets borne on slender rigid pedicels which are shorter than the adjacent pistillate spikelet; glumes unequal, membranaceous, the first usually very short, the second shorter than the floret; lemma usually 3-nerved; membranaceous, laterally compressed, 3-5-nerved; palea slightly shorter, 2-nerved; stamens 6.

The genus *Pharus* is confined to the tropics of the western hemisphere. The plants are unique in their broad, "commelinaceous" leaf blades, borne inverted and with strongly divergent veins. They may not be recognized as grasses by the casual observer. The panicles are rather fragile, readily breaking apart or separating from the plants. The rachis, panicle branches, and pistillate florets bear uncinat microhairs, those on the lemmas being conspicuous and serving to cause the mature pistillate florets to adhere to passing animals. (Bambusoideae: Phareae.)

KEY TO SPECIES OF *Pharus*

- 1a. Mature fruits (pistillate florets) at least 4 × as long as glumes, 20-23 mm. long, sigmoid, strongly divergent from branches of inflorescence *P. cornutus*
- 1b. Mature fruits less than 3 × as long as glumes, 17 mm. or less long, straight or sigmoid, appressed to branches 2
 - 2a. Leaf blades narrowly lanceolate, 3 cm. or less wide, 5-10 × longer than wide; culms long-decumbent, rooting at lower nodes *P. parvifolius*
 - 2b. Leaf blades elliptical to obovate, larger ones more than 3 cm. wide, less than 5 × longer than wide; plants caespitose 3
- 3a. Glumes of pistillate spikelets greenish or stramineous *P. virescens*
- 3b. Glumes of pistillate spikelets brown 4
 - 4a. Pistillate floret uncinat-pubescent only on exposed portion above tips of glumes *P. latifolius*
 - 4b. Pistillate floret pubescent nearly to base 5
- 5a. Fruit strongly sigmoid *P. mezii*
- 5b. Fruit straight *P. glaber*

Pharus cornutus Hack., Oesterr. Bot. Z. 52:9:528. 1902. Figure 180.

Perennial, caespitose in small clumps; plants erect, 50-70 cm. tall; culms unbranched, ca. 3 mm. thick, solid, glabrous; sheaths mostly longer than the internodes, overlapping, glabrous or minutely puberulent; ligule a lacerate membrane, 1.5-2.0 mm. long; blades flat, dark green, slightly roughened, broadly obovate, abruptly narrowed to an acuminate tip, 6-14 cm. long, 3-8 cm. wide, borne on a puberulent pseudopetiole ca. 1 cm. long. Peduncle exerted 6-15 cm.; peduncle, rachis, branches and spikelets all more or less densely pubescent with uncinat hairs; inflorescence an open panicle, 15-20 cm. long and about as wide; branches solitary, the spikelets borne in pairs on secondary or tertiary branches; staminate spikelets appressed to the branches, the pistillate ones strongly divergent. Pistillate spikelets with short glumes, ca. one-fourth as long as the floret; first glume subulate, 2.7-4.5 mm. long, 3-nerved; second glume 4.5-5.5 mm. long, narrowly triangular, 5-nerved; floret linear-cylindrical, sigmoid, firm, light-colored, heavily beset with uncinat hairs above, less densely so to the base, 20-23 mm. long, 7-nerved, the apical beak small, palea linear, as long as the lemma, firm, 2-nerved; stigmas 3. Staminate spikelets borne on stiff erect pedicels, the tip of the spikelets reaching about to the tips of the glumes of the paired pistillate spikelet; first glume subulate, 1.5-3.0 mm. long, 1-3-nerved; second glume ovate, 2.5-4.0 mm. long, 3-5-nerved; lemma thin, 3.0-5.0 mm. long, 3-nerved; anthers 6, 1.4-1.7 mm. long, yellow.

Rare; lowland rainforests, 70-250 m. elevation. February to July. Guapiles, La Selva, Finca Chirripó, Tsaki, Villa Quesada, Osa Peninsula. Endemic to Costa Rica.

Pharus glaber H.B.K., Nov. Gen. & Sp. 1:196. 1816. Figure 180.

Caespitose perennial; plants erect, 50-100 cm. tall, the culms unbranched, 3 mm. thick, solid, glabrous; leaf sheaths overlapping, glabrous; ligule membranaceous, 1.0-1.5 mm. long; pseudopetioles 10-20 mm. long; leaf blades dark green, 11-22 cm. long, 3.5-4.5 cm. wide, elliptical to narrowly obovate, tapering rather abruptly to a short triangular apex. Inflorescence solitary, terminal, 11-22 cm. long and about as wide, a very open panicle, the primary branches solitary; spikelets appressed to the secondary branches of the panicle; rachis and branches puberulent with uncinat hairs. Pistillate spikelets 8.2-12.0 mm. long; glumes lanceolate, brown, rather blunt, the first 4.2-5.8 mm. long, 3-nerved, the second 4.9-6.5 mm. long, 7-nerved; floret 8-12 mm. long, the lemma cylindrical with inrolled margins, obscurely 7-nerved, the back covered with uncinat hairs nearly to the base; apex a straight conical glabrous beak 1.0-1.5 mm. long; palea equal to the lemma. Staminate spikelets paired with the pistillate, on pedicels appressed to the rachis and nearly as long as the pistillate spikelets, 2.5-2.7 mm. long, not disarticulating; first glume 1.0-1.7 mm. long, lanceolate, 1-nerved; second glume 2.0-2.4 mm. long, ovate, 3-nerved; lemma 2.5-2.7 mm. long, ovate, apiculate, faintly 3-nerved; palea ca. one-fourth shorter than the lemma; stamens 6, the anthers 0.9-1.1 mm. long.

Rare; wet forests from 900-1,500 m. elevation; Sabalito, El Muñeco, Volcán Rincón de La Vieja. November to March. Mexico and the West Indies to Colombia, Bolivia, and northern Argentina.

Pharus latifolius L., Syst. Nat. ed. 10, 2:1269. 1759. Figure 180.

Caespitose perennial, 30-100 cm. tall, forming open clumps, culms unbranched, gla-



FIG. 180. *Pharus* species. *P. latifolius*: A, blooming plant; B, branch of panicle with two pistillate and a single staminate spikelet; *P. glaber*: C, two pistillate spikelets; *P. cornutus*: D, paired pistillate and staminate spikelets.

brous, ca. 3 mm. thick, solid; nodes glabrous; sheaths rather loose, keeled, glabrous, overlapping; ligule an erose brown membrane, 0.5-1.0 mm. long; blades borne on pseudopetioles up to 7 cm. long; blades narrowly to broadly obovate, 15-30 cm. long, 3-8 cm. wide, 3 to 5 $\times$ longer than wide, tapering rather abruptly to an acuminate apex. Inflorescence a solitary terminal panicle, up to 30 cm. long, broad, open, ca. as wide as long; rachis, peduncle, and branches puberulent with uncinete microhairs. Pistillate spikelets appressed to the branches, 10-17 mm. long; glumes brown, subequal, narrowly ovate, acute, rounded on the back, obscurely 7-nerved, ca. three-fourths as long as the floret; first glume 9-12 mm. long, the second 10-13 mm.; lemma stiff and cartilaginous, slightly curved, oblong-linear, rounded on the back, the margins involute over the palea and united just above the base; uncinete hairs abundant near the tip, extending downward about to the apex of the glumes, rarely further; glabrous conical beak of the lemma 1.0-1.5 mm. long; palea membranaceous, linear, 2-nerved, about as long as the lemma; lodicules not evident; style elongate, fleshy, the 3 stigmas slender, white; caryopsis oblong, 9-10 mm. long, curved, rounded on the lemma side, grooved on the palea side. Staminate spikelets brown, membranaceous, 2.8-4.0 mm. long; first glume 0.4-1.2 mm. long, ovate, acute, 1-nerved; second glume 1.8-2.0 mm. long, ovate, 3-nerved; floret 1, not disarticulating; lemma ovate, acute, 5-nerved, glabrous; palea equal to the lemma, 2-nerved; anthers 6, white, 1.4-1.7 mm. long. Chromosome number $n = 12$ from Costa Rican specimens.

Common in rain forests of the Caribbean lowlands; Pacific lowlands of southern Puntarenas Province; scattered elsewhere; sea level to 650 m. elevation. Blooming is apparently yearlong. Southern Mexico to Peru and Brazil; West Indies.

***Pharus mezii* Prodoehl, Bot. Arch. 1:250. 1922.**

Erect caespitose perennial; plants 50-100 cm. tall; culms unbranched, 1-2 mm. thick, glabrous below, increasingly puberulent toward the inflorescence; leaves basal, the sheaths glabrous; ligule ca. 1 mm. long, brown, membranaceous; leaf blades elliptical or obovate, flat, 11-25 cm. long, 2.3-5.0 cm. wide, slightly scaberulous, conspicuously cross-veined. Peduncle of isotype in US from base of the plant, without cauline leaves. Inflorescence solitary, terminal, an open panicle, that of the isotype 13 cm. long, about as wide, open pyramidal; branches solitary, spreading (note: this inflorescence may be fragmentary). Spikelets paired, appressed along the branches. Pistillate spikelets 9-11 mm. long; first glume 5.5-6.0 mm. long, 6-9-nerved, lance-ovate, acute, brown; second glume similar, 6.0-6.5 mm. long, 5-nerved; floret sigmoid, the lemma stiff, cylindrical, 9-11 mm. long, the margins incurved over the palea; nerves obscure, numerous; tip a glabrous pointed beak 0.5-1.0 mm. long; dorsal surface of lemma covered with hooked hairs at least half way to the base. Staminate spikelets on stiff slender pedicels ca. two-thirds as long as the glumes of the associated pistillate spikelet, appressed to the pistillate spikelet; first glume ca. 0.7 mm. long, second glume 1.7-1.9 mm. long, acute; lemma 2.4-2.7 mm. long; anthers not seen.

The type number, *Biolley s.n.* (Museo Nacional de Costa Rica 17326) was collected at Surubres, vertiente del Pacifico, altitude of 250 m., in February 1909. Costa Rica to Colombia.

Pharus parvifolius* Nash, Bull. Torrey Bot. Club 35:301. 1908. *P.

latifolius L., var. *angustifolius* (Nash) Prodoehl, Bot. Arch. 1:250. 1922.

Perennial; culms extensively trailing, branching freely from the nodes of the prostrate portions, the erect branches up to 1 m. long, unbranched; culms 3-6 mm. thick, solid, glabrous; nodes glabrous; sheaths glabrous, mostly overlapping; ligule a lacerate-ciliolate membrane, 0.5-1.0 mm. long; blades borne on margined pseudopetioles 6-30 mm. long; blades dark green, glabrous, but roughened beneath by the conspicuous commissural veins, 5-10 $\times$ longer than wide, 10-28 cm. long, 2.0-3.0 cm. wide, flat. Peduncle exerted up to 15 cm.; inflorescence an open panicle, up to 30 cm. long; branches mostly solitary; spikelets borne on second- or third-order branches, lying parallel to the branches. Pistillate spikelets subsessile; glumes subequal, ca. 7 mm. long, glabrous, lanceolate, 5-nerved; floret 12-15 mm. long, nearly straight, the lemma terminating in a glabrous conical beak ca. 1 mm. long; back of lemma covered with abundant uncinete hairs, less densely so nearly to the contracted base; nerves 7; margins incurved, spread apart in fruit, exposing a firm glabrous linear palea of about the same length; caryopsis free from the bracts, oblong, tan to brown, blunt at apex, tapering to a point at the base, convex on the lemma side, shallowly grooved on the palea side, 9-11 mm. long. Staminate spikelets borne on stiff erect pedicels appressed to the rachis and almost as long as the glumes of the adjacent pistillate spikelet; staminate spikelets 3.0-3.7 mm. long, narrowly ovate; first glume nerveless, deltoid to lanceolate, 0.7-1.4 mm. long, less than half as long as the spikelet; second glume and lemma subequal, 3-nerved, 3.0-3.7 mm. long; palea equal to lemma, 2-nerved; stamens 6, the anthers 1.8-1.9 m. long, tan. Chromosome number $n = 12$ from a Costa Rican specimen.

Rare; undisturbed moist forests, 500-1,200 m. This species is common in the forested canyon of the Río Reventazón at the CATIE at Turrialba. It has also been collected in the General Valley, at Finca Las Cruces near San Vito de Java, and in a few localities on the volcanoes of Guanacaste. It is abundant in moist forests above 1,100 m. on Volcán Rincón de la Vieja on Hacienda Guachipelin, and on Volcán Tenorio near Tierras Morenas. Blooming is apparently restricted to the dry season. Southern Mexico to Panama; West Indies and northern South America.

***Pharus virescens* Doell in Mart., Fl. Bras. 2:21. 1871.**

Perennial; bases decumbent and rooting; erect portions of culms to 1 m. tall, unbranched; culms solid, glabrous; sheaths overlapping, glabrous; ligule a ciliate membrane, ca. 1 mm. long; pseudopetioles broadly margined, elongated, scarcely differentiated from the sheath; blades large, light green, narrowly obovate, tapering rather abruptly to an acuminate apex, length 25-33 cm., width 4-7 cm. Peduncle ridged and grooved; panicles solitary, terminal, large and open, up to 30 cm. long and ca. as wide; spikelets appressed to secondary or tertiary branches; rachis and branches scabrous and beset with uncinete hairs; spikelets paired, or some of the pistillate ones solitary. Pistillate spikelets subsessile; glumes subequal, greenish or stramineous, not brown, narrowly triangular, the tip rather blunt; first glume 10-11 mm. long, 5-nerved; second glume similar, 10-12 mm. long; floret straight, cylindrical, flattened on the back, 13-15 mm. long, the terminal beak narrow, glabrous, 1.0-1.5 mm. long; back of lemma covered with uncinete hairs two-thirds of way to the base, these especially numerous near the

margins; palea equal to the lemma, linear, 2-nerved. Staminate spikelets borne on slender appressed pedicels from the base of the pistillate ones, the pedicel up to 10 mm. long; spikelets laterally compressed, 2.5-4.2 mm. long; first glume ca. 1.2 mm. long, 1-nerved, ovate, acute; second glume 2.5-4.2 mm. long, 3-nerved, narrowly ovate, acute; lemma 2.5-2.7 mm. long, narrowly ovate, 3-nerved, its palea equal; anthers 6, purple, 0.7-0.9 mm. long. One staminate spikelet with 2 florets and a total of 8 anthers was found.

Rare, lowland forests; apparently blooming from January to March. El General, Shirores, Hamburg Finca. Guatemala to Peru and Brazil; Hispaniola.

PHRAGMITES Adanson

REFERENCES: H. J. Conert, Die Systematik und Anatomie der Arundineae, 1-208. Cramer. Weinheim. 1961. W. D. Clayton, The correct name of the common reed, *Taxon* 17:168-69. 1968. E. D. Voss, Additional nomenclatural and other notes on Michigan monocots and gymnosperms, *Michigan Bot.* 11:26-37. 1972.

Tall stout perennial reeds with plummy panicles; spikelets several-flowered; glumes narrow, the first 3-nerved, the second 5-nerved, shorter than the florets; an evident internode between the first and second glumes; disarticulation above the first floret and at the base of the rachilla internode beneath each succeeding floret; rachilla internodes, except the lowermost, covered with numerous long, silky hairs; lowermost floret persistent with the glumes, its lemma 5-nerved, the flower staminate; other florets with 3-nerved lemmas and perfect flowers; lemmas slender, acuminate, glabrous; paleas much shorter than the lemmas; uppermost florets shorter than the lower ones, so that the tips of all lemmas are at approximately the same level.

Phragmites is a genus of about four species, widespread in the temperate and warmer zones of the world. It is most closely related to other large reeds such as *Arundo*, *Gynerium*, and *Cortaderia*. (Arun-dinoideae: Arundineae.) The genus *Phragmites* is known from all the continents except Antarctica. Authors recognize from one to several species, which appear to be poorly defined.

***Phragmites australis* (Cav.) Trin. ex Steud., Nom. Bot. ed 2, 2:324. 1841. *Arundo australis* Cav., Ann. Hist. Nat. 1:100. 1799. *Phragmites communis* Trin., Fund. Agrost. 134. 1820. *Arundo phragmites* L., Sp. Pl. 81. 1753. Figure 181.**

Plants forming large colonies; culms erect, unbranched except when injured, 2-8 m. tall, up to 2 cm. thick, hollow, glabrous; rhizomes abundant, longitudinally ridged, hollow, 1-2 cm. thick; leaves numerous, the sheaths usually overlapping, glabrous except for auricular hairs 5-7 mm. long; blades glabrous, 30-50 cm. long, 15-25 mm. wide, flat; peduncles mostly included; panicle solitary, rather dense, up to 45 cm. long, pyramidal, drooping; lower branches numerous, whorled, naked at the base; spikelets very numerous, compactly arranged on the outer portions of the branches, wedge-shaped, 11-15 mm. long; first glume 3.8-5.2 mm. long, 3-nerved, ovate, acute; second glume 5.5-6.5 mm. long, 5-nerved, ovate, acute; florets 3-5, the lowermost ones 9-10 mm. long, the

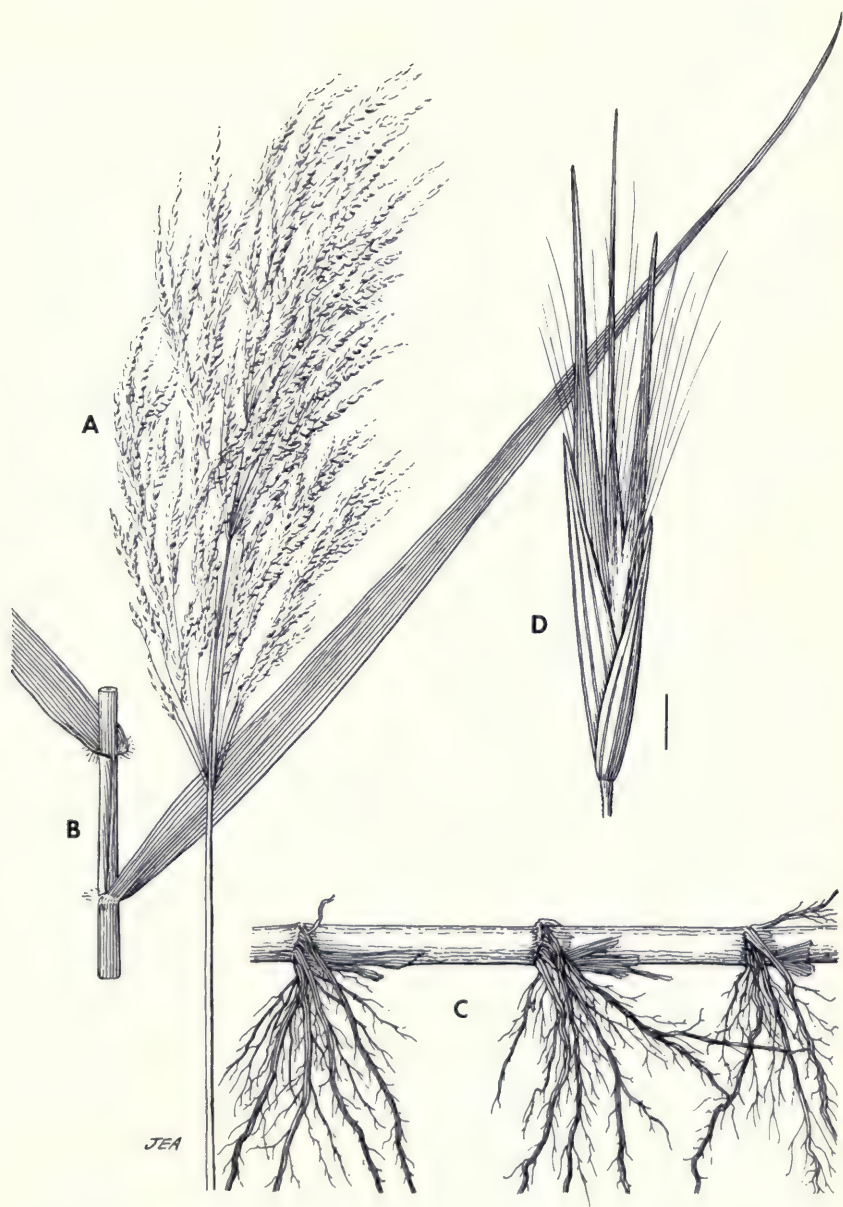


FIG. 181. *Phragmites australis*. A, panicle; B, leaf bases with auricular hairs; C, rhizome; D, spikelet. Drawn from fertile material.

uppermost much shorter; lemmas lance-attenuate; paleas 2-3.5 mm. long; anthers 1.4-2 mm. long, yellow. Chromosome count $2n = 72$ obtained from vegetative internodes of the sterile strain from Trinidad.

This species is rare in Costa Rica and uncommon in Central America in general. We have specimens from Trinidad, Laguna Bonilla, the Limón area, and Finca Las Cruces near San Vito de Java. The colony from Trinidad, on the south slope of Volcán Turrialba, fills a large marsh. Although the plants are very tall, they never bloom in nature. We have been able to induce the formation of sterile inflorescences in the greenhouse at Iowa State in February 1973 and July 1975. No fertile spikelets occurred in any of these inflorescences. Most spikelets were minute rudiments, the largest about 5 mm. long. Another sterile colony occurs on Finca Las Cruces. The other collections from Costa Rica bear spikelets that are malformed or sterile in varying degrees, and such sterility is extremely common in this species in Central America. The description given above is taken from Central American specimens, and may not apply closely to material from the temperate zone. Various chromosome numbers have been reported for this species.

PHYLLOSTACHYS Siebold & Zuccarini

REFERENCE: F. A. McClure, Bamboos of the genus *Phyllostachys* under cultivation in the United States, U.S.D.A. Agriculture Handbook 114. pp. 1-69. 1957.

Bamboos of slender growth habit; rhizomes extensive; culm internodes hollow, D-shaped in cross section, flattened above the insertion of the branch buds; primary branches typically 2 at each node, unequal, sometimes a third smaller one present; culm sheaths papery, the apex rounded to a narrow reduced blade; foliage leaf blades pseudopetiolate, readily deciduous; leaf blades small, flat, tessellate. Inflorescence a panicle whose branches bear clustered pseudospikelets (complex bracted structures that resemble spikelets, but are internally branched into 1 or more true spikelets). Pseudospikelets enveloped in conspicuous inflated sheaths that bear reduced blades and enclose 2-3 spikelets. Spikelets bearing 1-3 many-nerved empty bracts (glumes) at the base; florets 1-3, the terminal one rudimentary; lemmas acuminate, many-nerved; palea about equal to the lemma, 2-keeled, many-nerved; lodicules 3, flat, vasculated; stamens 3; ovary with a single style and 3 stigmas.

Phyllostachys is a small Asiatic genus, important for several cultivated species, used for ornament, fishpoles, timber, paper, and edible shoots. (Bambusoideae: Arundinariae.)

Phyllostachys aurea A. & C. Riviere, Bull. Soc. Natl. Acclim. France, Sér. 3:716. 1878. *P. bambusoides* Sieb. & Zucc., var. *aurea* (A. & C. Riv.) Makino. Figure 182.

Long-lived bamboo; rhizomatous; clumps dense to open; culms up to 10 m. tall, erect or



FIG. 182. *Phyllostachys aurea*. A, leafy branch; B, culm sheath; C, pseudospikelet.

slightly arching; internodes 1-4 cm. thick, hollow, glabrous, D-shaped in cross section; nodes prominent; some culms, but not all, have a succession of several short internodes near the base; culms branching freely from middle and upper nodes, with usually 2 unequal branches at each node, sometimes a third smaller one; branches slender but stiff, rebranching; main culm sheaths up to 20 cm. long, the margins ciliate; apex rounded, bearing a narrow linear reduced blade; foliage leaves borne on minor branchlets, usually 3-8 per branchlet; leaf sheaths ciliate on the margin; oral setae sometimes present; ligule a short, thick ciliolate membrane, puberulent on the back, 0.7-0.8 mm. long; external ligule a minute thick rim; leaf blades flat, tessellate, 4-10 cm. long, 5-16 mm. wide, ovate 5-6:1, abruptly acuminate, base rounded to a short flattened pseudopetiole; margins scabrous; lower surface puberulent near the base, sometimes all over the surface. Inflorescence a terminal panicle of clustered pseudospikelets, up to 35-50 cm. long, open, with rigid ascending or spreading branches; much smaller inflorescences occur on sheared specimens. Pseudospikelets numerous, ascending and overlapping, often with small rigid bracts at their bases; spikelets concealed by inflated external bracts, bearing reduced leaf blades, spikelets 1-several in each pseudospikelet. Spikelets usually with a single acuminate, 9-11-nerved cylindrical glume, ca. as long as the spikelet; some spikelets have 2 glumes; florets 1-2; rachilla internode supporting the lowermost floret thickened to the apex, sometimes puberulent; disarticulation at the base of the lowermost floret; florets cylindrical, acuminate, the lemma 9-11-nerved, enveloping the palea; rachilla internode prolonged 4-5 mm. beyond the ultimate floret and bearing a rudiment at its apex; palea ca. as long as the lemma, several-nerved, clasping the rachilla internode, the keels prolonged as 2 short awns; lodicules 3, flat, vasculated; anthers 3, yellow, 12-13 mm. long; ovary bearing an elongated style with 3 short stigmas at its apex. Chromosome number $n = 24$ from a Costa Rican specimen.

This is the common yellow-stemmed bamboo, often used for sheared hedges or allowed to grow naturally as a tall screen. It occurs commonly around San José and is occasionally found blooming. Flowering plants have been seen in the Parque Bolívar, around the zoological garden. A sheared hedge along Calle 33, S of La Luz bloomed in 1968, without death of the plants. The individual inflorescences were small and leafy. A tall clump along Hwy. 204 N of the Colegio de Abogados had culms 4-5 m. tall which were in flower in December 1968. These culms were dying after flowering. Flowering habits of this species in the western hemisphere are not well known, but our experience in Costa Rica suggests that at least minimal blooming, without cane death, may be fairly frequent. A large blooming panicle from Virginia, collected by Dr. Allard, bears the notation that the plant had been transplanted 15 years before and had remained vegetative for that period. The species is native to China.

POA Linnaeus

Plants perennial or rarely annual, caespitose or rhizomatous; culms unbranched. Inflorescence a terminal panicle, the branches usually clustered. Spikelets several-flowered, laterally compressed, disarticulating above the glumes and between the florets; glumes shorter than the florets, the first 1-nerved, the second usually 3-nerved;

lemmas folded, 5-nerved, acute or blunt, awnless; midnerve, marginal and intermediate nerves often pubescent; the blunt callus in some species bearing a tuft or web of crimped, cottony hairs.

A large genus of temperate and arctic zones of the world, poorly represented in the tropics. Many of the species are highly apomictic and extremely variable. The genus is related to *Festuca*, from which it differs in the rather blunt, awnless lemmas and in the leaf tips, which are blunt and cupped like the prow of a boat. (Pooideae: Poeae.)

KEY TO SPECIES OF *Poa*

- 1a. Plants rhizomatous; lemmas bearing elongated web of cottony hairs and also pubescent on keel, marginal, and intermediate nerves; pastures on volcanoes
P. pratensis
- 1b. Plants not rhizomatous; lemmas variously pubescent, with or without a web. . . 2
 - 2a. Basal foliage stiff and erect, the elongated leaf blades folded, sharp-tipped; glumes nearly as long as spikelet; lemmas densely scabrous with short, stiff hairs; summit of Chirripó Grande *P. chirripoensis*
 - 2b. Foliage soft, leaf blades flat; glumes shorter than lowermost lemma; lemmas not densely scabrous; plants of middle altitudes 3
- 3a. Lemmas ciliate on keel, marginal, and intermediate nerves; no cottony web present; low, spreading plants, 5-35 cm. tall *P. annua*
- 3b. Lemmas ciliate on keel, rarely also on marginal nerves; cottony web present at least on lowermost lemma; plants usually erect, 20-100 cm. tall 4
 - 4a. Ligules 4-10 mm. long; lower branches of panicles 3-7 per node . . *P. trivialis*
 - 4b. Ligules less than 2 mm. long; lower panicle branches 1 or 2 per node
P. talamancae

Poa annua L., Sp. Pl. 68. 1753. Figure 183.

Duration annual or indefinite; plants 5-35 cm. tall, erect and tufted, or in wet habitats, becoming long-decumbent and rooting at the nodes; branching from the base or from the nodes of decumbent stems; prophylla prominent, up to 2.5 cm. long; culms soft, glabrous; leaf sheaths mostly overlapping, glabrous; ligule a thin white membrane, 1-4 mm. long, decurrent on the sheath margins; blades 0.5-11.0 cm. long, 1-4 mm. wide, soft, flat, blunt-tipped, the uppermost much reduced. Plants of wet habitats have much larger leaves than those of drier sites. Peduncle included or exserted up to 11 cm.; inflorescence a solitary terminal panicle, 2-7 (11) cm. long, pyramidal, the branches solitary or paired, the spikelets densely clustered near their tips. Spikelets laterally compressed, green or purplish, 4.0-5.5 mm. long, disarticulating above the glumes and between the florets; first glume ovate, acute, 1-nerved, 1.5-2.7 mm. long; second glume obovate, acute, 3-nerved, 2.2-3.3 mm. long, shorter than the lowermost floret; florets 2-6; lemmas 2.6-3.8 mm. long, ovate, rather blunt, often bronzy near the apex; nerves 5, all silky-pubescent, the internerve area near the base also sometimes pubescent; palea slightly shorter than its lemma, silky-ciliate on the keels; anthers 3, yellow, 0.9-1.2 mm. long. Chromosome number $n = 14$ from Costa Rican specimens.

Open moist areas, ditches, pastures; Meseta Central, Poás, Irazú, Cerro de la Muerte; elevations from 1,100 to 3,400 m. Apparently blooming yearlong. Worldwide in cool climates; apparently introduced

in the New World. In North America, it extends southward to Volcán Chiriqui in Panamá.

***Poa chirripoensis* Pohl, Fieldiana, Bot. 38:10. 1976. Figure 184.**

Perennial; densely caespitose; culms erect, unbranched, 37-58 cm. tall, hollow, glabrous, elliptical in cross section; nodes dark, not prominent; basal foliage abundant, the blades stiff, erect, up to 30 cm. long, reaching about to midculm; sheaths keeled, slightly scabrid, those of the 2-3 short culm leaves shorter than the internodes; ligule a thin membrane, 2.0-4.5 mm. long, tapering abruptly to a point; leaf blades 2-3 mm. wide, stiff, permanently folded, erect, tapering abruptly to a sharp rigid cusp, the surfaces minutely roughened. Peduncle smooth, exserted 7-25 cm.; inflorescence a solitary terminal panicle, open, pyramidal, 6-8 cm. long, 3-5 cm. wide; branches paired, spreading, flexuous, bearing a few peglike hairs like those of the lemmas; pedicels thick, scabrous in lines with similar hairs; spikelets clustered toward the outer ends of the branches. Spikelets 3.7-4.4 mm. long, 1-2-flowered, the glumes keeled, 3.5-4.0 mm. long, nearly as long as the florets; first glume triangular 5:1 as folded, the second slightly wider, both 3-nerved, tapering to acuminate tips, scabrous on the keels and nerves; lemmas ovate, 3.5-3.9 mm. long, 4:1-5:1 as folded, blunt-tipped, densely scabrous in lines with thick, stiff, round-tipped hairs 0.05-0.10 mm. long; callus usually with a few short cobwebby hairs; palea nearly as long as the lemma, scabrous on the keels with hairs similar to those of the lemmas.

This species known only from the type specimen, *Burger & Liesner 7448*, collected from the rocky summit of Chirripó Grande at 3,820 m. *Poa chirripoensis* is easily distinguished from others in Central America by its dense cluster of stiff, erect, basal leaves, and by the unique spicule-like hairs of the lemmas. It is not closely related to any other North American species.

***Poa pratensis* L., Sp. Pl. 67. 1753. Figure 183.**

Vigorous perennial; plants erect, (10) 30-70 (110) cm. tall; rhizomes abundant, slender, scaly, elongated; leafy innovations abundant at the bases of the clumps; culms unbranched, glabrous, hollow, thin-walled, round in cross section, the nodes round; sheaths shorter than the internodes, glabrous; blades up to 21 cm. long, the basal ones largest, 1-5 mm. wide, flat, dark green, glabrous; ligule a thin white membrane, 0.2-3.0 mm. long. Peduncle slender, exserted up to 20 cm.; panicle solitary, terminal, 3-14 cm. long, pyramidal, usually open, the branches mostly naked near the bases, the spikelets clustered near the outer ends; lower branches usually 5 per node, several of them much shorter than the others. Spikelets laterally compressed, 4.0-6.5 mm. long; the glumes and lemmas keeled; disarticulation above the glumes and between the florets; first glume 2.0-3.0 mm. long, ovate, acute, 1-3-nerved; second glume ovate, acute, 3-nerved, 2.6-3.7 mm. long; florets 2-5; lemmas 3-4 mm. long, the uppermost ones shorter than the lower, ovate or obovate, rather blunt, 5-nerved, often purple-marked near the tip, the margins scarious; keel and marginal nerves silky-hairy; callus with a conspicuous web of cottony hairs; palea slightly shorter than its lemma, scabrous on the keels; anthers 3, yellow, 1.3-1.7 mm. long.

Moist pastures at upper elevations, Irazú and Turrialba; Villa Mills;



FIG. 183. *Poa* species. *P. talamancæ*: A, spikelet; B, floret; *P. pratensis*: C, spikelet; D, floret; *P. annua*: E, plant; F, spikelet; G, floret; *P. trivialis*: H, spikelet; I, floret.

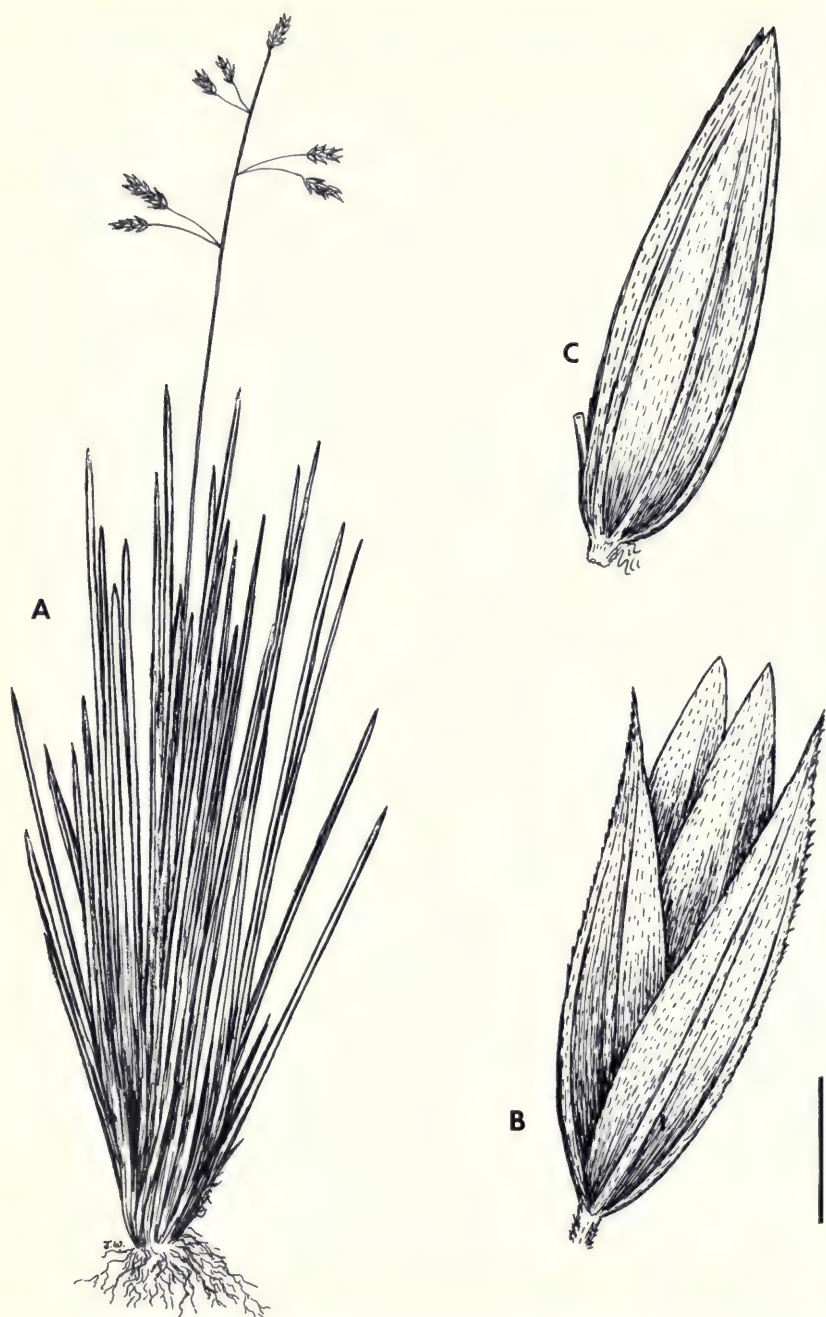


FIG. 184. *Poa chirripoensis*. A, plant habit; B, spikelet; C, floret.

elevations 2,600-3,100 m. Cosmopolitan in moist cool climates of the world; introduced from Europe.

This is one of the most widely used pasture and lawn grasses in cool climates. Along with many temperate-zone pasture grasses, it was apparently introduced in the dairy areas of the volcanoes of the Meseta Central. Most of these species are not well adapted and survive only marginally. The earliest collection from Costa Rica was dated 1924.

***Poa talamancae* Pohl, Fieldiana, Bot. 38:8. 1976. Figures 183, 185.**

Plants perennial, caespitose in dense tufts with abundant basal foliage; sheaths of basal leaves keeled; blades flat, olivaceous, 3-14 cm. long, 2-4 mm. wide, their surfaces minutely scaberulous, the margins scabrous, tip conspicuously cucullate; basal foliage often floccose with fungus hyphae; culms erect or somewhat decumbent at the base, slender, 20-60 cm. tall; internodes 3, ca. 1 mm. thick, hollow, glabrous, slightly scabrid, with a light-colored band just below the prominent, purple nodes; culm leaves usually 3; sheaths much shorter than the internodes, glabrous, slightly keeled and scabrid on the keel; ligule a thin membrane, up to 2 mm. long; blades of culm leaves flat, 2-6 (14) cm. long, 2-4 mm. wide, the uppermost usually short. Peduncle exserted up to 11 cm.; inflorescence a solitary terminal panicle, 8-11 cm. long, up to 6 cm. wide, very open, the solitary or paired slender flexuous branches up to 3 cm. long. Spikelets few, appressed along the outer halves of the branches, 4.5-5.6 mm. long, laterally compressed, usually purple; glumes shorter than the florets, the first ovate as folded, 1-nerved, 1.8-2.9 mm. long; second glume oblong to obovate, 3-nerved, 2.3-3.4 mm. long, both glumes scabrous on the keel; florets 2-3, the rachilla prolonged beyond the last one as a slender bristle one-third to one-half as long as the floret, sometimes bearing a minute rudiment at its tip; lemmas oblong-obovate in side view, 5-nerved, 3.1-4.1 mm. long; lower third to half of the keel silky-ciliate, as also the basal portion of the marginal nerves; upper part of the keel and surface of the lemma scabrid; at least the lowermost lemma bearing a scant cottony web on the callus; palea about equal to the lemma, scabrous on the keels; anthers 3, yellow, 1.1-1.3 mm. long; caryopsis brown, narrowly ovoid, 2 mm. long.

Poa talamancae is not closely related to any other species of *Poa* found in Costa Rica. It is probably to be assigned to the informal group *Palustres* of Hitchcock. It appears most similar to *P. orizabensis* Hitchc., Contr. U.S. Natl. Herb. 17:374. 1913, a Mexican species, from which it differs in the abundant soft, flat, basal leaf blades, 3 stem nodes, longer ligules, and larger spikelets with longer lemmas. The specific name is derived from the Talamanca Range. This species is endemic to The Cerro de la Muerte, and has been collected twice from the area of Asunción, on open, windswept páramos above 3,300 m. elevation. Blooming dates February to July.

***Poa trivialis* L., Sp. Pl. 67. 1753. Figure 183.**

Caespitose perennial, the culm bases often decumbent; plants 20-100 cm. tall, the foliage light green; culms unbranched, hollow, glabrous; nodes conspicuous, dark, con-

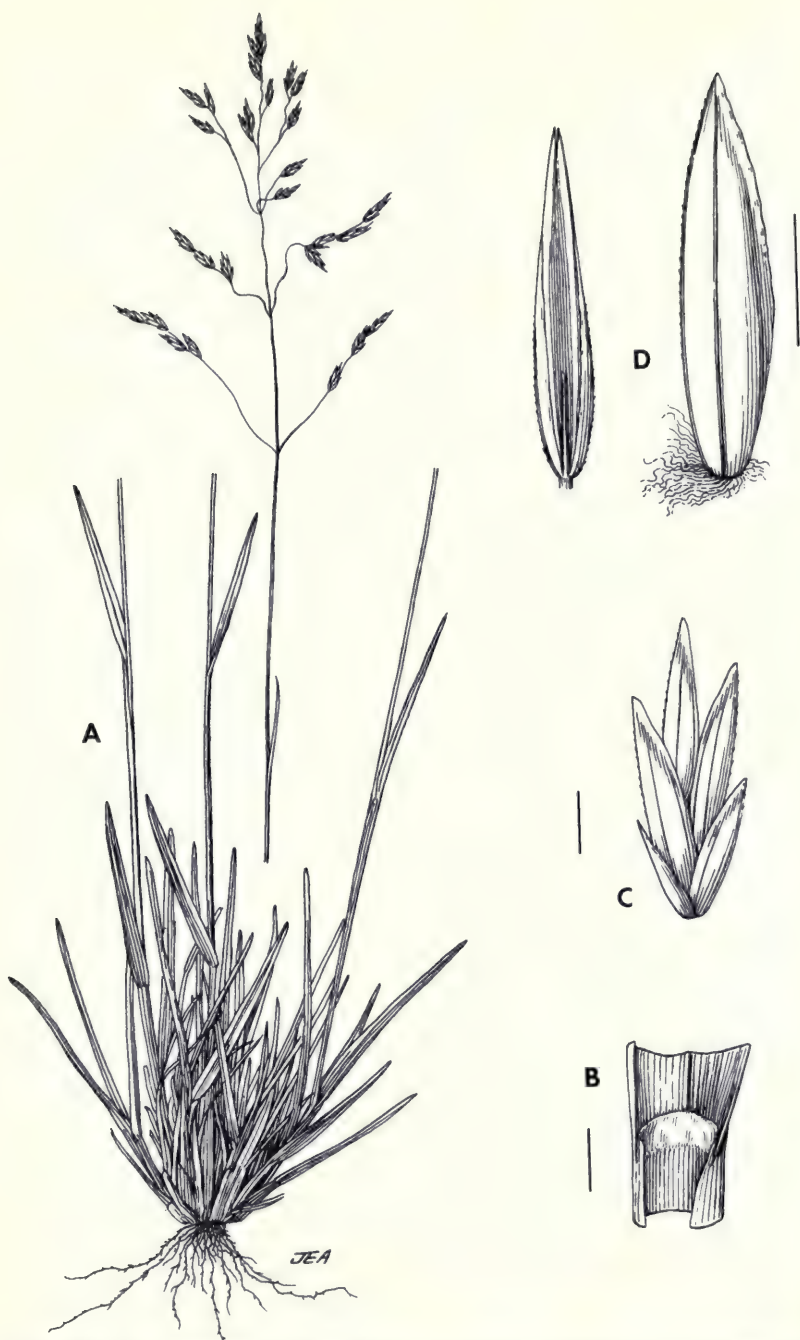


FIG. 185. *Poa talamancae*. A, plant habit; B, ligule; C, spikelet; D, two views of a floret.

tracted; sheaths usually scabrid but not visibly pubescent; ligule a thin white acute membrane, 4-10 mm. long; blades 3-20 cm. long, flat, 1.5-6.0 mm. wide, scabrid. Inflorescence a solitary terminal panicle, 3-25 cm. long, up to 15 cm. wide, pyramidal, open or rather dense, the branches 3-7 at the lower nodes, the longer ones naked at the base. Spikelets appressed to the branches, light green or purplish, 3-4 mm. long, laterally compressed, disarticulating above the glumes and between the florets; first glume 2-3 mm. long, lanceolate, acute, 1-nerved; second glume 2.5-3.5 mm. long, ovate, acute, 3-nerved; florets 2-4, the lemmas 2.5-3.5 mm. long, oblong-lanceolate in lateral view, the margins infolded, the nerves conspicuous; keel short-ciliate at least on the lower half, the lemma otherwise glabrous except for a cottony web attached to the callus; palea nearly as long as the lemma, the keels scabrid; anthers 3, 1.5-2.0 mm. long.

Rare; moist pastures, 2,600-2,800 m. elevation; Irazú and Turrialba. August and February. Widespread in temperate North America; introduced from Europe and not previously reported from Central America. This species, like *P. pratensis* and *P. annua*, was probably introduced in pasture seed from Europe.

POLYPOGON Desfontaines

Caespitose perennial; inflorescence a terminal panicle; spikelets disarticulating with the attached slender pedicels; glumes narrow, subequal, awned, 1-nerved; lemma much shorter than the glumes, thin and membranaceous, awned, 5-nerved; rachilla not prolonged beyond the floret. (Pooideae: Agrostideae.)

Polypogon elongatus H.B.K., Nov. Gen. & Sp. 1:134. 1816. Figure 186.

Plants forming small clumps; culms erect, unbranched, 1-3 mm. thick, hollow, glabrous; nodes shrunken, dark; culm leaves 5-6, the sheaths longer or shorter than the internodes, glabrous; ligule 4-8 mm. long, a whitish membrane, scaberulous on the back, decurrent on the sheath margins; blades flat, thin, glabrous, scaberulous above, 15-30 cm. long, 4-15 mm. wide; peduncle glabrous, up to 30 cm. long; panicle solitary, 10-30 cm. long, 1-7 cm. wide, rather dense but lax, the branches covered with spikelets to their bases; rachis, branches, and pedicels scabrous; spikelets crowded along the branches, laterally compressed, disarticulating at the base of the pedicel which ranges from short to longer than the spikelet; glumes similar, the first a little longer than the second, narrow, tapering to a short awn, 1-nerved, scabrid on the keel and surface; first glume 3-5 mm. long, the second 3-4.5 mm. long, including awns 1-2 mm. long; floret much shorter than the glumes and concealed by them, usually not disarticulating separately; lemma thin, membranaceous, glabrous, ovate, blunt, 5-nerved, the lateral nerves extending into blunt apical teeth; midnerve extending into a scabrid awn 1.2-2 mm. long, arising from the cleft apex of the lemma; palea very thin, inconspicuous, nerveless, 0.4-0.5 mm. long; anthers 3, 0.5-0.7 mm. long, pale yellow. Chromosome number $n = 28$ from Costa Rican material. A South American count of $n = 14$ has also been reported.

Occasional at middle elevations around the Meseta Central and on the Cordillera de Talamanca; moist roadsides and forests, 1,450-2,700 m. elevation. July to September; January. Mexico to Argentina.



FIG. 186. *Polypogon elongatus*. A, panicle; B, spikelet; C, floret.

POLYTRIAS Hackel

Low stoloniferous perennial; inflorescence a solitary terminal rame; spikelets paired or in triads at each node of the thin, disarticulating rachis, one of each set pedicellate, and one or two sessile; spikelets of each set equal and fertile, awned, dorsally compressed; glumes equal, oblong, truncate, membranaceous; margins of first glume incurved over the edges of the second; second glume oblong, truncate, keeled; sterile lemma absent; fertile lemma minute, hyaline, bifid almost to the base, a twisted and geniculate brown awn arising in the cleft; anthers 3; style branches naked below; palea lacking. One species of the Asiatic tropics, naturalized in Africa and the western hemisphere. (Panicoideae: Andropogoneae.)

Polytrias amaura (Büse ex Miquel) Kuntze, Rev. Gen. Pl. 2:788. 1891. *Andropogon amaurus* Büse ex Miquel, Pl. Jungh. 360. 1854. *Pogonatherum amaurum* (Büse) Roberty, Monogr. Andropog. 393. 1960. *Polytrias praemorsa* (Nees) Hack. in DC, Monogr. Phan. 6:189. 1889. *Pollinia praemorsa* Nees in Hooker, J. Bot. Kew Misc. 2:98. 1850 (Nomen). *P. praemorsa* Nees ex Steud., Syn. Pl. Glum. 1:409. 1855. Figure 187.

Plants creeping by numerous stolons, the erect portions of the culms 10-15 cm. tall, unbranched; culms 0.5-1.0 mm. thick, glabrous, hollow; nodes bearded; sheaths keeled, ciliate on the margins, and sometimes slightly pubescent near the apex; ligule a minute ciliate membrane, 0.2-0.5 mm. long; blades flat, 0.5-5 cm. long, ca. 2 mm. wide, loosely hirsute on both surfaces. Peduncle 1-2 cm. long; inflorescence slender, rather dense, 2-3 cm. long, brownish silky; rachis internodes flat, 2-3 mm. long, brownish ciliate on the edges and strongly bearded at the apex. Spikelets dorsally compressed, brownish silky, ovate, 3-4 mm. long; the equal glumes completely covering and concealing the fertile floret; fertile lemma thin, hyaline, 1 mm. long; awn exerted up to 4-7 mm., brown, twisted and geniculate; anthers purple, 2.2-2.4 mm. long. Chromosome number $n = 10$ from Costa Rican material.

This delicate little creeping grass has been found in Costa Rica only in the lawn behind the main building of the IICA at Turrialba, where it forms the principal component of a lawn. The plants are recognizable by the somewhat purplish cast which they lend to the turf. It was blooming in late November. Previously, it has been known from Central America only by a few collections from the Canal Zone. It is native in southeastern Asia, Java, and the Philippines and has been reported as an introduction from Camaroun, the Caribbean Islands, and Venezuela. Common name: "Java grass."

The name *P. praemorsa* has sometimes been used for this species. Although the basionym, *Pollinia praemorsa*, was published four years earlier than any other specific epithet, no description accompanied the name, and none was published until 1855.



FIG. 187. *Polytrias amaura*. A, growth habit; B, a triad of spikelets.

PSEUDECHINOLAENA Stapf

Creeping, broad-leaved grasses; inflorescence a terminal panicle of a few slender racemes; spikelets paired, appressed along the lower sides of the slender rachis, or frequently one of the pair abortive or missing; disarticulation below the glumes. Spikelets laterally compressed, half-oval, the straight side nearest the rachis, the glumes and tip of the sterile lemma appressed-hispid when young, at maturity beset with thick columnar bristles which are retrorsely barbed at the tips; first glume acuminate, from two-thirds to as long as the spikelet, 3-nerved, folded; second glume as long as the spikelet, 5-nerved, strongly boat-shaped, bearing rows of pustulose-based apically barbed bristles between the nerves; sterile lemma as long as the spikelet, broadly oblong, rounded to a blunt flattened folded tip, chartaceous, faintly 5-nerved, but with a large thin hyaline area occupying the lower back, about half the length of the lemma; palea chartaceous, linear, its margins inrolled, ca. two-thirds as long as the lemma; a staminate flower rarely present; fertile (second) floret ca. two-thirds as long as the spikelet, its lemma narrowly ovate, acuminate, coriaceous, smooth and shining, its margins thick and overlapping the edges of the palea but not inrolled; palea of equal length and similar texture.

One species in the tropics of both hemispheres. (Panicoideae: Paniceae.)

Pseudechinolaena polystachya (H.B.K.) Stapf, in Prain, Fl. Trop. Africa 9:495. 1919. *Echinolaena polystachya* H.B.K. Nov. Gen. & Sp. 1:119. 1816. Figure 188.

Duration indefinite; culms up to 1 m. long, the basal portions extensively creeping and branching, rooting erect portions of culms unbranched; prophylla prominent, papillose-hirsute on the keels; nodes hirsute; internodes more or less hirsute, especially toward the apex; ligule a ciliate brownish membrane, 0.5-1.5 mm. long; sheaths usually much shorter than the internodes, more or less hirsute, especially toward the apex; leaf blades lanceolate, asymmetric, 1.5-7.5 cm. long, 5-16 mm. wide, appressed-hirsute on both surfaces; peduncle included or exserted up to 15 cm., minutely pubescent to hirsute; panicles 7-20 cm. long, the few racemose branches 3-6 cm. long, slender, the spikelets appressed along their lower sides. Spikelets 3.2-4.0 (4.4) mm. long, strongly laterally compressed; first glume 2.5-3.6 mm. long, ovate, acuminate, 3-nerved; second glume 3.2-4.0 mm. long, 5-nerved, keeled, boat-shaped; lower (sterile) lemma 3.0-3.7 mm. long; fertile lemma 2.0-2.2 mm. long, narrowly ovate, acuminate, its palea similar; anthers 3, 1.2-1.5 mm. long, yellow. Chromosome number $n = 18$ from Costa Rican specimens.

Forest and brushy areas, in dense shade, frequently along trails; mostly on the Pacific Slope, from southern Costa Rica to Turrialba and the Meseta Central; Tilaran area; Guapiles and Guacimo; blooming yearlong. Mexico to Brazil and Argentina; in the Old World from Tropical Africa and Asia.

The spikelets of this forest grass exhibit a great change in appearance during maturation. Young spikelets are appressed-hispid, but as the fruit matures, the stiff, spinelike hairs are elevated on thick, hollow multicellular hairs. The points of the spines are directed down-



FIG. 188. *Pseudechinolaena polystachya*. A, panicle; B, immature spikelet with spines appressed to the bracts; C, mature spikelet with spines elevated and reflexed.

ward, and the whole spikelet acts like a small bur. Bor states that ripe spikelets frequently become attached to the legs of cattle in India, and we have often had them become attached to our clothing in Costa Rica.

RADDIA Bertolini

Caespitose perennial low grasses of rain forests; leaf blades short, distichous, crowded, all in one plane. Spikelets unisexual, in the same or different inflorescences. Pistillate spikelets: dorsally compressed, disarticulating above the equal glumes; floret 1, borne on a thick rachilla internode and falling attached to it. Staminate spikelets: laterally compressed, lacking glumes; floret 1; stamens 3. Lodicules in both sexes 3, flat, truncate.

This small genus is closely related to *Cryptochloa*, *Lithachne*, *Dian-drolyra*, and *Olyra*. Generic limits in this group are not well known, and new discoveries in the group are frequent. (Bambusoideae: Olyreae.)

***Raddia costaricensis* Hitchc., Proc. Biol. Soc. Wash. 40:87. 1927. Figure 189.**

Caespitose perennial, forming dense clumps of numerous wiry slender culms, their upper portions arching and spreading; culms up to 38 cm. long, the lower 2-3 internodes much elongated, comprising three-fourths of the total length, naked or with short bladeless sheaths; internodes slender, hollow, glabrous; nodes constricted; apex of the internodes enlarged; foliage crowded at the apex of the culms, the 5-20 leaves forming flat sprays, their sheaths closely overlapping, the upper half of each sheath densely papillose-pilose with tan hairs; ligule a minute ciliate membrane, ca. 0.5 mm. long; pseudopetiole thick, pulvinar, 0.5-1.0 mm. long, papillose-pilose like the sheaths; blades narrowly ovate, 5-7:1, 35-43 mm. long, 4.5-9 mm. wide, flat, or revolute in drying, densely papillose-pilose beneath, with a few scattered hairs above; edges scabrous. Peduncles included in the sheaths; inflorescences usually several, usually a many-flowered one from the axil of one of the lower foliage leaves, and a small one at the apex of the culm, the branches slender and delicate, usually curved. Spikelets unisexual, both kinds borne in the same inflorescence. Pistillate spikelets: One to several, borne at the apex of the inflorescence, dorsally compressed, outline ovate 4:1, the pedicels thick and flattened; glumes 2, equal, exceeding the floret, 8-9 mm. long, whitish, membranaceous, acuminate, the first 11-nerved, the second narrower, 9-nerved; floret solitary, dorsally compressed, borne on the apex of a thickened rachilla internode ca. 1 mm. long and deciduous with it; lemma 5.5 mm. long, 5-nerved, the margin, lower back, and rachilla heavily bearded with cottony hairs; palea equal in length, with 2 keel nerves, plus 2 faint nerves between the keels and 2 faint marginal nerves; lodicules 3, flat, truncate; style 1; stigmas 2, large, plumose, apically exserted; caryopsis not seen. Staminate spikelets: Laterally compressed, narrowly ovate, 3.0-3.7 mm. long, contracted into a short callus at the base; glumes absent; lemma thin, membranaceous, 3-nerved; palea equal, 2-nerved; lodicules 3, flat, truncate; stamens 3, the anthers yellow, 1.7-1.8 mm. long. Chromosome number $n = 11$.

This species was first collected on the Río Hondo near Madre de Diós, by Pittier in 1896. It was not found again until 1966, when it was relocated at the type locality by Dr. T. R. Soderstrom. We have col-

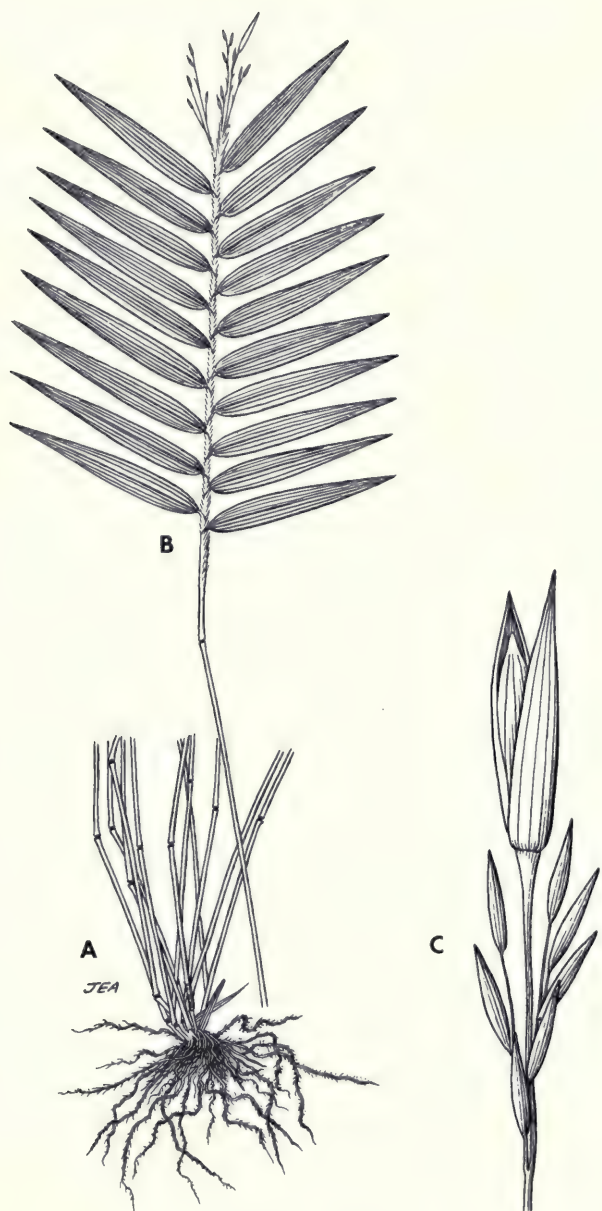


FIG. 189. *Raddia costaricensis*. A, plant base; B, leafy culm with inflorescences; C, inflorescence with a terminal pistillate spikelet and staminate spikelets below it.

lected it again in the same locality in 1969. The plants are rare and scattered in dense rain forest.

This species has recently been transferred to a new genus, *Arberella* Soderstrom & Calderón, and will be designated as *Arberella costaricensis* (Hitchc.) Sods. & Cald., *Brittonia* 31:439. 1979.

RHIPIDOCLADUM McClure

REFERENCE: F. A. McClure, Genera of bamboos native to the New World, (Gramineae: Bambusoideae), *Smithsonian Contr. Bot.* 9:101. 1973.

Caespitose bamboos; clumps of few to many stems; culms thornless, hollow, cylindrical, in most species slender and graceful, arching and drooping, often forming foliage curtains on canyon walls; branches numerous, the fan-shaped cluster originating from a flattened triangular meristem just above the node; individual branches slender, unbranched or with 1 or 2 solitary branchlets; foliage leaves borne on their distal parts. Inflorescences in our species terminal on the branches, mostly 1-sided and slender, the spikelets subsessile or sessile in 2 rows on the lower side of the rachis. Spikelets several-flowered, laterally compressed, disarticulating above the glumes and lowermost (sterile) lemma and between the florets; glumes 2 (3 in *R. harmonicum*), unequal; lowermost floret sterile or with a rudimentary flower; lemmas 5-7-nerved, acuminate or short awned; palea 2-keeled and with several weak nerves on the lateral flanges; lodicules 3; stamens 3; stigmas 2; caryopsis not seen; most spikelets appear sterile and empty.

The species of *Rhipidocladum* in Costa Rica are usually recognizable by their very slender, gracefully arching (or trailing in *R. maxonii*) growth habit and unarmed, hollow, cylindrical stems with elongated internodes, usually less than 1 cm. thick. *Rhipidocladum harmonicum* is exceptional in its more erect growth habit and thicker culms. Blooming is infrequent, but sterile plants can be recognized by their triangular, flattened branch meristems and by the midculm leaf sheaths, which have deltoid, erect, reduced blades. Species 11, ranging from Mexico to Brazil, Bolivia, Peru, and Ecuador, at low, frost-free elevations. (Bambusoideae: Arthrostylideae.)

VEGETATIVE KEY TO SPECIES OF *Rhipidocladum*

- 1a. Delicate sprawling or trailing plants; culms less than 3 mm. thick, usually less than 3 m. long; leaf blades 2-4 cm. long, 2.5-4 mm. wide *R. maxonii*
- 1b. Erect or arching plants; culms 5-20 mm. thick, up to 20 m. long; leaf blades 6-12 cm. long, 6-15 mm. wide 2
 - 2a. Mature culms ca. 2 cm. thick *R. harmonicum*
 - 2b. Mature culms less than 1 cm. thick 3
- 3a. Apex of leaf sheath prolonged into erect auricles that are adnate to ligule; auricular bristles usually absent; larger leaf blades 9-17 mm. wide *R. pittieri*

- 3b. Apex of leaf sheath truncate at level of insertion of pseudopetiole, usually bearing auricular bristles; leaf blades mostly 6-8 mm. wide *R. racemiflorum*

Rhipidocladum harmonicum (Parodi) McClure, Smithsonian Contr. Bot. 9:105. 1973. *Arthrostylidium harmonicum* Parodi, Physis 19:479. 1944.

Caespitose bamboo; clumps of few culms, 10-20 m. long, nearly erect or arching above; rhizomes not seen; culms ca. 2 cm. thick, smooth and glabrous, cylindrical; internodes green, thin-walled, hollow, 35 cm. long or more, often waterfilled when young; nodes not prominent; midculm sheaths much shorter than the internodes, more or less appressed-hispid on the surface, especially near the base and on the exposed edge; collar marked by a partial row of hispid bumps; ligule a thick, minutely ciliate membrane, ca. 1 mm. long, slightly arched; sheath blade erect, as wide as the sheath apex at its base, up to 7 cm. long, half of the length being a narrow acuminate "tail"; margins of the blade papillose-hispid in tufts. Foliage-bearing lateral branches of the culms numerous at each middle and upper node, arising from the edges of a flattened triangular meristematic plate in a fan-shaped group; individual branches slender, up to 40 cm. long, their proximal nodes bearing short bladeless sheaths, the foliage leaves 5-6, borne on the outer two-thirds of the branch; sheath apex terminating in rounded auricles, bearing flattened bristles up to 8 mm. long; ligule a thick, slightly ciliate membrane, ca. 1 mm. long, slightly arched; pseudopetioles 2-3 mm. long, glabrous or minutely puberulent; blades flat, scaberulous, the midrib evident only near the base, 8-13 cm. long, 13-16 mm. wide, ovate 6-8:1, the base rounded, asymmetric; surfaces glaucous, glabrous except for small woolly tufts on the lower surface at the base. Inflorescence a simple terminal spike; rachis flexuous, 4-6 cm. long; spikelets few (4-6), glabrous, 1.5-2 cm. long; sterile bracts 3-4, membranaceous, acute, glabrous, the first obsolete or scalelike; second acute, 3-nerved, glabrous, 3.5-4 mm. long; third acute or slightly obtuse, 7-nerved, 6-8 mm. long; fourth similar but larger, 7.5-9 mm. long; fertile lemmas 9-11-nerved, 11 mm. long, the apex acute, awnless; palea slightly shorter than the lemma, 2-keeled, the keels ciliate; lodicules lanceolate, acuminate; anthers 3, 6.0-6.5 mm. long. (Description of spikelets from Parodi.)

Rare; Río Conejo, Cañas Gordas, and Bajo Pacuare. At the last site, several clumps were seen near the road, about 3 km. E of the Río Pacuare. The young culms were strictly erect. Their internodes contained water. Elevation 1,000-1,200 m. The identification of these specimens is somewhat tentative, since they are the only North American collections, and all are sterile. The Río Pacuare specimen is a good match for *W. H. Camp E 1613* from Ecuador, in US.

Rhipidocladum maxonii (Hitchc.) McClure, Smithsonian Contr. Bot. 9:105. 1973. *Arthrostylidium maxonii* Hitchc., Proc. Biol. Soc. Wash. 40:80. 1927. Figure 190.

Delicate, vinelike bamboo, the culms 1-3 m. long, arching or trailing in brush; rhizomes very short, scaly; culms arising separately or in small clumps, scaly at the base; internodes elongated, 10-18 cm. long, naked, cylindrical, glabrous, hollow, 1.5-2.5 mm. thick; nodes not prominent, glabrous or retrorsely appressed-pubescent; foliage leaves

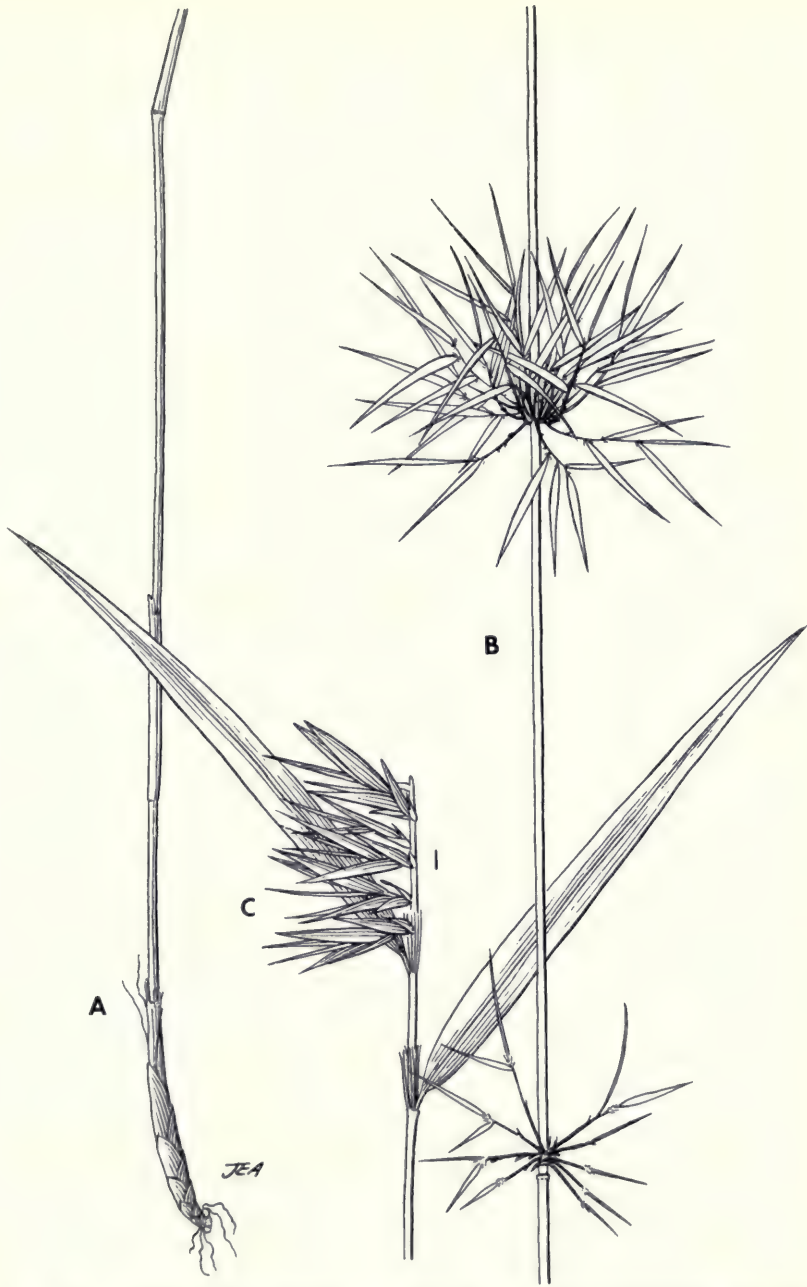


FIG. 190. *Rhipidocladum maxonii*. A, culm base; B, branch complements and culm internodes; C, inflorescence.

borne on primary branches that arise in a dense semi-verticel of 30 or more from a flattened triangular appressed meristem that arises just above each node; branches very slender, the lower internodes exposed, the foliage aggregated toward the tip; leaves several per branch, their sheaths mostly overlapping; exposed sheath margin puberulent in a line that extends down the internode below; auricular bristles slender, whitish, 6-8 mm. long; pseudopetiole ca. 1 mm. long, puberulent on one margin, the line of hairs continuing along one margin of the leaf blade lower surface, the remainder of the under-surface with only scattered elongated hairs; ligule minute, a ciliolate membrane 0.1-0.2 mm. long; leaf blades flat, light green, linear, 2-4 cm. long, 2.5-4.0 mm. wide, glabrous above, scabrous on the margins. Inflorescences numerous, borne at the tips of the primary branches, small, 8-10 mm. long, the few spikelets borne in 2 rows on one side of the flattened rachis, crowded and standing out at right angles to the rachis; peduncles included in the uppermost sheath or exerted 3-8 mm. Spikelets sessile or nearly so, 8-10 mm. long, laterally compressed; first glume 1.2-1.5 mm. long, ovate, 1-nerved; second glume 2.0-2.7 mm. long, the two closely adjacent; a thick rachilla internode borne above them; lowermost floret sterile, consisting of an empty lemma 3.5-4.2 mm. long, 4-5-nerved, ovate 2:1, acute; disarticulation usually above the sterile lemma; upper florets, with the exception of the reduced terminal one, with paleas, the palea ranging from nearly as long as the lemma to much shorter; lemmas ovate, 5.0-6.4 mm. long, acute, 7-9-nerved, glabrous (except in the type number, which has pilose lemmas); palea 2-keeled; anthers 3, yellow, 4.2 mm. long; ovary with a single short style and 2 stigmas; fruit not seen; most florets appear empty.

Region south of Cartago. The type (*Maxon & Harvey 8154*) is from Santa Clara de Cartago. Other flowering specimens are *Standley 33543* from El Muñeco and *Standley 39179* from La Estrella. The only known flowering dates are 1923, 1924, 1955, and 1972. Our recent collections from El Muñeco and El Empalme area are vegetative. The latter collection (*Pohl & Lucas 13005*) consists of small seedlings and young plants, so that it may be inferred that the plants have flowered recently. Because of their small size and habit of growing in brush, the plants are quite inconspicuous. Wet forests and brushy slopes. Endemic to Costa Rica.

This is one of the most easily recognized of the Costa Rican bamboos, because of its delicate, vinelike aspect and the peculiar pubescence patterns of the sheaths, blades, and culm internodes.

***Rhipidocladum pittieri* (Hack.) McClure**, Smithsonian Contr. 9:105. 1973. *Arthrostylidium pittieri* Hack., Oesterr. Bot. Z. 53:75. 1903. Figure 191.

Caespitose bamboos, in clumps of up to ca. 50 culms; rhizomes pachymorph, the clumps dense; culms very slender, less than 1 cm. thick, up to 10 m. long, their lower portions arching, the upper part long-drooping, the colonies forming graceful curtains of foliage on canyon walls; internodes elongated, cylindrical, greenish, thin-walled, glabrous; culm sheaths purplish, glabrous except the felty exposed margin; ligule a stiff membrane, ca. 0.5 mm. long, slightly arching, minutely ciliolate; blade erect, triangular, about as wide as the sheath apex, coarsely hispid on the lower margins and upper



FIG. 191. *Rhipidocladum* species. *R. racemiflorum*: A, branch complement of a blooming plant; B, leaf blade; *R. pittieri*: C, leaf blade; D, spikelet.

surface near the base; leafy branches from all of the middle and upper culm nodes, borne in dense fan-shaped clusters of up to 50, arising from a flattened, appressed triangular meristematic plate just above the node; leafy branches very slender, mostly unbranched, up to 60 cm. long, bearing several foliage leaves on the outer half; lower blades deciduous, the sheaths persistent; sheaths glabrous, terminating in erect auricles that are adnate to the ligule; ligule a membrane, 1.5-2.5 mm. long; pseudopetiole 1.5-4.0 mm. long, puberulent; blades abscissing with the pseudopetiole; blades flat, 7-12 cm. long, 6-16 mm. wide, glabrous except for a dense tuft of woolly hairs on one side of the midrib at the base of the abaxial surface; midrib not conspicuous except near the base of the blade; margins scabrous; outline narrowly ovate, 7-10:1, acuminate. Inflorescences usually solitary and terminal on the branchlet, rarely several on one branch. Peduncle included or exerted up to 1 cm. Inflorescence a slender, 1-sided raceme, 3-10 cm. long, less than 1 cm. thick; spikelets subsessile in 2 rows, alternating on the lower side of the rachis, their stiff, appressed pedicels 1-2 mm. long. Spikelets ca. 2 cm. long, laterally compressed, stramineous or whitish, the bracts often green-spotted; first glume acicular, 2.5-4.5 mm. long, tapering into an awn tip; second glume 4.9-6.7 mm. long, ovate, acuminate, 5-nerved; lowermost lemma empty, lacking palea and flower, 6.5-7.9 mm. long, ovate 3:1, 7- or rarely 9-nerved, acuminate or awn-tipped, the awn up to 2 mm. long; rachilla internode above the sterile lemma thick and stiff, up to 4 mm. long; spikelets disarticulating above the lowermost lemma and between the remaining florets; well-developed florets 1-3, the rachilla terminating in a reduced slender lemma; upper lemmas 10-11 mm. long, ovate 3:1, tapering to an awn tip 1-2 mm. long; nerves usually 7; upper margins of the lemmas short-ciliate; awn upwardly scabrous; palea about equal to the lemma, ciliate near its tip; keels 2, the marginal flanges of the palea each having several faint nerves as well; upper rachilla segments slender, ca. 4 mm. long; lodicules flat, brownish; anthers 3, yellow, 3.5-6 mm. long; fruit not seen.

Costa Rican collections of this species are from the canyon of the Río Virilla, SW, N, and NE of San José. Type material (*Tonduz 7193*) was marked "Río Virilla, prés San Juan" (possibly Tibás). The plants are abundant on the canyon walls at Puente de Mulas, near San Antonio, where I first observed it in vegetative condition in 1968. Subsequent observations indicated that the plants remained in vegetative condition until 1973. The specimens of the type number available to me are small fragmentary flowering branchlets. The collection date was 1892. No subsequent specimens were collected in either vegetative or flowering condition until 1973. In that year, Roy Lent collected it in flowering condition from the Río Virilla between San Miguel Sur and Paracito. I found the large stand in bloom at Puente de Mulas in June 1973. All plants were in the reproductive stage, and no new culms were found. The spikelets were disarticulating very freely. No evidence of stamens or mature fruit could be seen. I revisited the same locality in December 1974, at which time all old plants were dead. A very limited number of seedlings were found along the trail on the south side of the Río Virilla, above the powerhouse. They were usually found growing in litter on the tops of flat boulders or in clefts between the rocks. It seems evident from the nearly complete absence of sta-

mens, the lack of developed caryopses, and the paucity of seedlings, that most of the spikelets are sterile.

Rhipidocladum racemiflorum (Steud.) McClure, Smithsonian Contr. Bot. 9:106. 1973. *Arthrostylidium* ? *racemiflorum* Steudel, Syn. Pl. Glum. I:336. 1854. Figure 191.

Slender bamboos; rhizomes pachymorph, the plants forming dense clumps; culms numerous, 10-15 m. long, arching and trailing or ascending into trees, cylindrical, hollow, 5-10 mm. thick, glabrous; internodes elongated; nodes not enlarged; sheaths of main culms mostly glabrous, or the exposed margin slightly felty; ligule a stiff membrane, slightly arched, ca. 0.5 mm. long, minutely ciliate; blades reduced, erect, ca. as wide at the base as the sheath apex, triangular, acuminate, ca. 3-4 cm. long, the margins coarsely hispid-ciliate near the base; upper surface somewhat coarsely pubescent near the base; foliage-bearing branches numerous (60-80 per node), arising from the edges of a flattened triangular meristem borne just above the node, forming a fan-shaped cluster; lower sheaths of each branchlet bladeless, the several leaf blades borne on the outer portion of the branch; primary branches sometimes bearing 1 or 2 solitary secondary branches from their distal nodes; sheaths shorter than the internodes, mostly glabrous except for the puberulent margins (more puberulent in juvenile plants); apex of sheaths truncate, usually bearing auricular bristles up to 8 mm. long, these readily deciduous; ligule minute, a thin membrane 0.2-0.5 mm. long; pseudopetioles 1.0-1.5 mm. long, glabrous or puberulent; leaf blades flat, 6-8 cm. long, 5-9 mm. wide; midrib scarcely visible except at the base; upper surface glabrous; lower surface with a tuft of woolly hairs on one side of the midrib at the base, sometimes also with some appressed pubescence on the lower surface. Peduncles included or exerted up to 8 mm.; inflorescences numerous, solitary at the tips of primary branches or terminal on a secondary branchlet; inflorescence a slender, one-sided raceme; rachis thin, slightly arching, 4-6 cm. long; spikelets usually ca. 10, appressed to the lower side of the rachis in 2 rows, borne on short appressed pedicels less than 1 mm. long, inserted 3-5 mm. apart. Spikelets 14-18 mm. long, laterally compressed, disarticulating above the sterile lemma and between the larger florets; first glume 2.8-3.9 mm. long, acicular from a broadened base, 3-nerved; second glume 4.4-5.3 mm. long, including the awn tip, triangular 2.5:1, 5-nerved; lowermost lemma sterile, lacking a flower and a palea, ovate, 6.0-6.5 mm. long, 5-7-nerved, the rachilla internode above it thick and stiff, 1 mm. long; well-developed florets usually 2, frequently a reduced sterile one above the second; disarticulation at the apex of the rachilla internode above the sterile lemma and between the 2 florets; lemmas 8-10 mm. long, ovate 3:1, 5-7-nerved, ciliate near the apex with short, stiff hairs; awn apical, 1-2 mm. long; palea as long as or longer than the lemma, somewhat bowed out above the base, evidently 2-keeled, stiffly ciliate on the upper portions of the keels and on the tip; marginal flanges of the palea faintly nerved; stamens 3; anthers 5 mm. long, yellow; well-developed ovaries or caryopses not seen.

This species is scattered at low altitudes in Guanacaste and the Nicoya Peninsula and occurs in the western part of the Meseta Central as well. A single specimen from the General Valley is the southernmost record in Costa Rica. The plants are graceful and delicate, the numerous culms often arching and trailing. They occur on savannas and in open forest, often along streams and canyon walls. The species

is monocarpic, like *R. pittieri*, the plants dying after flowering. Blooming is apparently fairly frequent. I have seen flowering or fruiting specimens from Costa Rica dated 1926, 1939, 1941, and 1973. The two collections from 1973 are my numbers 12962 and 12963, both from the flanks of Volcán Tenorio. These two colonies were separated by ca. 5 km. The plants were in an advanced stage of "fruiting" when collected in June 1973. The spikelets were freely disarticulating, although most of the florets appeared to be empty, and no developed ovaries and few anthers could be found. These colonies were not relocated, but I found another colony of the same species (13060) along the Río Tenorio 3 km. S of Río Naranjo, in December 1974. In this colony, all mature plants were dead and rapidly disintegrating. Numerous seedlings were found about the dead plants. They ranged up to 50 cm. tall and were beginning to produce short rhizomes. The leaf-bearing branches were borne in small fascicles and lacked the well-developed flat triangular meristematic plate that characterizes mature plants.

RHYNCHELYTRUM Nees

Caespitose perennial; inflorescence a panicle. Spikelets densely covered and concealed with purplish or white silky hairs that are twice as long as the bracts; spikelets laterally compressed, the outline pyriform; first glume linear, much shorter than the spikelet; second glume and sterile lemma subequal, keeled, elevated on a short stipe above the first glume; second glume 5-nerved, ovate, strongly keeled, tapering abruptly to a narrow apex, bearing a short straight awn from just below the tip; lower lemma very similar to the second glume, but with a staminate flower, the erect palea nearly as long as the lemma, ciliate at the tip; fertile floret a third shorter than the spikelet, laterally compressed, boat-shaped, smooth and shining, chartaceous, obscurely nerved, the margins thin, not inrolled; palea about equal to the lemma.

This common weedy grass is easily recognized by the extremely silky-pink, purple, or silvery-white inflorescences. About 25 species of this genus are native to Africa. (Panicoideae: Paniceae.)

***Rhynchelytrum repens* (Willd.) Hubbard**, Kew Bull. (1934):110. 1934. *Tricholaena rosea* Nees, "Cat. Sem. Hort. Vratisl. a. 1836"; Fl. Afr. Austr. 1:17 1841. *T. repens* (Willd.) Hitchc., Man. Gr. W. Ind. 331. 1936. *Rhynchelytrum roseum* Stapf & Hubb. ex Bews, World's Grasses 223. 1929. Figure 192.

Rather slender caespitose perennial; culms up to 1 m. tall, erect or the bases sometimes decumbent, branching from the base or from lower nodes, hollow, papillose-hirsute; the nodes bearded; prophylla up to 3 cm. long, pubescent; sheaths shorter than the internodes, papillose-hirsute, the upper ones glabrous or nearly so; ligule a circle of stiff hairs, 0.8-1.2 mm. long; blades 6-17 cm. long, 2-5 mm. wide, more or less papillose-hirsute; plants leafy below, the upper blades reduced and usually glabrous. Panicles terminal on the culms, solitary, oval, pedicels very delicate and flexuous, long-hairy near



FIG. 192. *Rhynchelytrum repens*. Plant, panicle, spikelet, fertile floret.

the apex. Spikelets 3.5-4.5 mm. long, but appearing twice that because of the long pubescence; first glume 1 mm. long, linear; second glume and lower lemma subequal, 3.5-4.0 mm. long, carinate; lower lemma concealing a staminate flower, the palea 3 mm. long, closing off the cavity of the lemma, ciliate at the apex; fertile floret readily deciduous, the lemma boat-shaped, 2.2-2.5 mm. long, awnless, the flower perfect; anthers 3, 2.1-2.3 mm. long, tan. Chromosome number $n = 18$ from Costa Rican material.

Common; open areas or partial shade, roadsides and cafetals, banana plantations, from sea level to 1,700 m. Probably blooming yearlong. This African species occurs in Florida and from Mexico to Brazil; Caribbean Islands. We have no records from the Caribbean slope in Costa Rica, but this species probably occurs there.

Common names: *Zacate ilusión*, *Zacate de seda*, "Ruby grass," "Natal grass."

ROTTBOELLIA Linnaeus fl.
Nomen Conservandum

Tall caespitose plants; inflorescence a terminal or axillary pedunculate cylindrical rame; spikelets and pedicels sunken into the thick, hollow rachis, which disarticulates into single internodes at maturity. Each internode has a fleshy knoblike projection at the base which fits into a cavity in the apex of the internode below. Spikelets paired on each internode, the sessile spikelet of each pair perfect-flowered, its coriaceous, many-nerved, convex, ovate first glume with an acute tip and a transverse notch near the base; second glume coriaceous, many-nerved, deeply boat-shaped, closely lining the cavity of the thick internode; sterile lemma flat, 3-nerved, membranaceous, its palea hyaline, shorter than the lemma; floret perfect; anthers 3, yellow; styles naked below, stigmas purple. Pedicellate spikelet shorter than the fertile one, its flat, coriaceous, many-nerved pedicel united along one margin to the edge of the rachis internode, and together with the first glume of the sessile spikelet, completely closing off the cavity of the rachis internode. Pedicellate spikelet sterile, consisting of a flat, ovate, acute, many-nerved first glume bifid at the tip, with infolded margins and a slightly smaller 3-nerved second glume enclosing a small rudimentary floret.

Closely related to the similar genera *Manisuris*, *Coelorachis*, and *Hemarthria*. A small genus of several species native to the tropics of the Old World, one species introduced in tropical America. (Panicoideae: Andropogoneae.)

Rottboellia exaltata L. f., Sup. Pl. 114. 1781. *Stegosia exaltata* (L.f.) Nash, N. Amer. Fl. 17:84. 1909. Figure 193.

Tall annual, the plants up to 2 m. tall, erect, freely branching, the bases of culms often somewhat decumbent and with long, stiff prop roots; prophylla up to 8 cm. long, split near the tips; internodes glabrous, pithy; nodes glabrous; leaf sheaths strongly bristly with papillose-based stiff hairs; ligule a stiff membrane, ca. 1 mm. long; leaf blades numerous, up to 40 cm. long and 20 mm. wide; midrib conspicuous, wide and white; blades tapering to a narrow base, the upper surface hispid, the lower glabrous. Peduncles terminal and axillary, slender, flattened, angular; rame cylindrical, 1-3 mm. thick, 7-15 cm. long, stiff; individual internodes 6.0-8.5 mm. long. Sessile spikelet 3.7-5.0 mm.

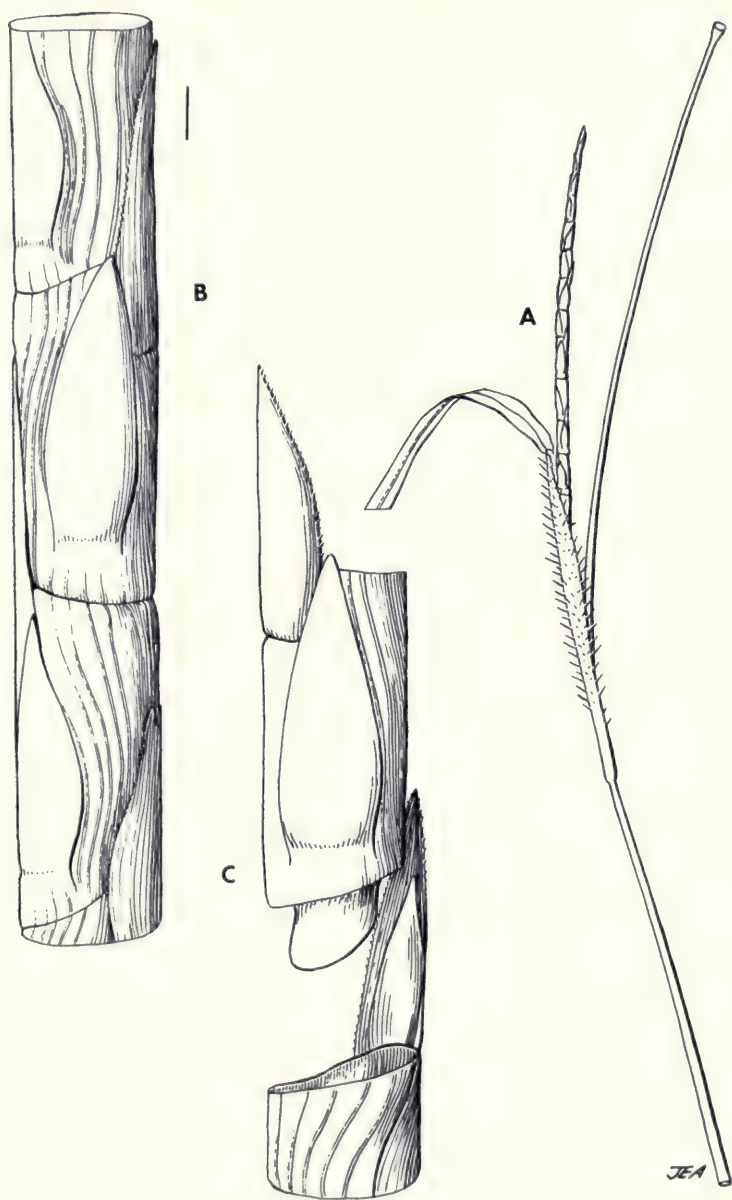


FIG. 193. *Rottboellia exaltata*. A, axillary inflorescence; B, portion of a rame, showing spikelets sunken into the rachis; C, spikelet pair, showing disarticulation from a lower internode.

long; pedicellate spikelet shorter than the sessile one and always sterile. Terminal portion of the rame gradually reduced to a slender rachis bearing rudimentary spikelets. Chromosome number $n = 10$ from Costa Rican material.

Occasional weed along streams and in pastures; mostly at low elevations. Limón area, Siquirres, Turrialba, Quepos, Puntarenas, Guanacaste. Blooming apparently yearlong. This Old World species occurs in southern Florida and the West Indies. The Costa Rican occurrences indicate rather recent introduction, but the plants are spreading aggressively.

The stiff bristly hairs on the leaf sheaths are very irritating, since they break off readily and penetrate the skin. Costa Rican farmers indicate that livestock also reject the plants. Other chromosome numbers have been reported from Asia.

SACCHARUM Linnaeus

REFERENCE: E. Artschwager & E. W. Brandes, Sugarcane (*Saccharum officinarum* L.): Origin, Classification, Characteristics, and Descriptions of Representative Clones, Agriculture Handbook No. 122. U.S. Dept. Agric. 307 pp. 1958.

Tall perennial grasses with thick, solid stems having many short internodes. Inflorescence a large terminal plummy panicle of numerous elongated rames, which disarticulate at maturity into individual internodes, each bearing a spikelet pair, one spikelet of each pair sessile and one borne on a short pedicel. Spikelets equal, bisexual, awnless, dorsally compressed, somewhat boat-shaped; acute, callus of spikelets short, truncate, bearing numerous silky hairs several times as long as the spikelets; first glume and second glume subequal, longer than the internal spikelet parts and concealing them, chartaceous; first glume flat on the back, usually 4-nerved and lacking a midrib; second glume boat-shaped, 3-5-nerved; lower (sterile) lemma slightly shorter than the first glume, flat on the back, 2-nerved, ciliate on the upper margins, thinner than the glumes; upper (fertile) lemma much smaller than the lower one, or absent, often reduced to a thin, subulate membrane, ciliate at the tip; palea absent; lodicules 2, truncate, vasculated; stamens 3; stigmas 2, on slender, naked style branches, usually exerted laterally from the spikelet.

A small genus of about six species of the Asiatic tropics, including many hybrid, polyploid, or apomictic forms that are difficult to place; plants wild or frequently cultivated for sugar production. The genus is closely related to *Erianthus*, *Miscanthus*, *Imperata*, and *Eriochrysis*. (Panicoideae: Andropogoneae.) Sugarcane, the only representative of the genus in the Americas, is readily recognized by its large size, thick solid culms with numerous nodes, and plummy panicles. It might possibly be confused with *Gynerium sagittatum* (*Caña brava*), which is found only in the wild, and has several-flowered unisexual spikelets and nonsweet culms, bearing their leaves in fan-shaped clusters near the apex. Common names: "Sugarcane," *Caña de Azúcar*.

Saccharum officinarum L., Sp. Pl. 54. 1753. Figure 194.

Giant grasses, mature plants becoming several meters tall; caespitose (but planted from buried culms that sprout at the nodes); culms many-noded, solid, usually unbranched, sweet, of various colors, up to 5 cm. thick; lower leaf blades and sheaths often disarticulating from mature culms; internodes usually glabrous and often strongly bluish-glaucous; sheaths longer than the internodes, overlapping, glabrous or pubescent, sometimes producing auricles at the apex; ligule a thick short membrane; blades rather stiff and spreading, 1-2 m. long, narrow at the base and widest at the middle, glabrous or the broad midrib pubescent; margins very scabrous. Peduncle stout, cylindrical, bearing a solitary terminal panicle; inflorescence large, silky with white or pinkish hairs. Spikelets mostly 3-4 mm. long, glabrous except for the long hairs on the short, blunt callus; lower lemma flat, conforming to the first glume, and slightly shorter than it; upper lemma 1.5-2.5 mm. long, thin and membranaceous, nerveless, ciliate at the tip, sometimes absent; anthers ca. 2.0 mm. long. Numerous chromosome numbers have been reported for cultivated strains of this species, but $n = 20$ or 40 are the most common.

Widely cultivated at lower elevations for sugar production. Rarely, spontaneous individuals may be seen on field margins or roadsides, but these are probably survivors of cultivation. Blooming is highly irregular, and the season for a particular stand may depend on day length, altitude, rainfall, the genetic individuality of the clone, and other factors. Bloom is most frequent during the short days of the year. Native to the Asiatic tropics.

SACCIOLEPIS Nash

Inflorescence a dense or spikelike panicle, rarely reduced to a spikelike raceme; internodes hollow; spikelets flattened on the first glume side or biconvex; second glume and sterile lemma boat-shaped, equal, somewhat saccate near the base; first glume much shorter than the spikelet, 3-5-nerved; second glume with 7-9 conspicuous nerves; sterile lemma 5-7-nerved, with a short or well-developed palea and sometimes a staminate flower; upper floret much shorter than the sterile lemma, lanceolate to ovate, dorsally compressed, acute, chartaceous, smooth and shining, awnless; margins of lemma not inrolled; palea similar to the lemma, both bracts very obscurely nerved.

The genus is closely related to *Hymenachne*, from which it differs in having hollow internodes. About 40 species, in the tropics of the eastern hemisphere, with a few in the Americas. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Sacciolepis*

- 1a. Delicate sprawling plants with thin culms; uppermost leaf blade usually 1-4 cm. long; ligule minute, 0.1-0.3 mm. long; spikelets 2.5-2.8 mm. long *S. indica*
- 1b. Erect tufted plants; culms thick, somewhat succulent; uppermost leaf blade 15-25 cm. long; ligule 1.0-2.5 mm. long; spikelets 2.0-2.2 mm. long *S. myuros*

***Sacciolepis indica* (L.) Chase, Proc. Biol. Soc. Wash. 21:8. 1908.**
Aira indica L., Sp. Pl. 63. 1753. (As *A. spicata*, corrected in Errata, end Vol. II.) Figure 195.

Probably perennial; plants tufted or with decumbent or weakly rhizomatous culm



FIG. 194. *Saccharum officinarum*. Blooming plant, portion of a panicle consisting of several rames, a sessile spikelet with a pedicel and rachis internode.

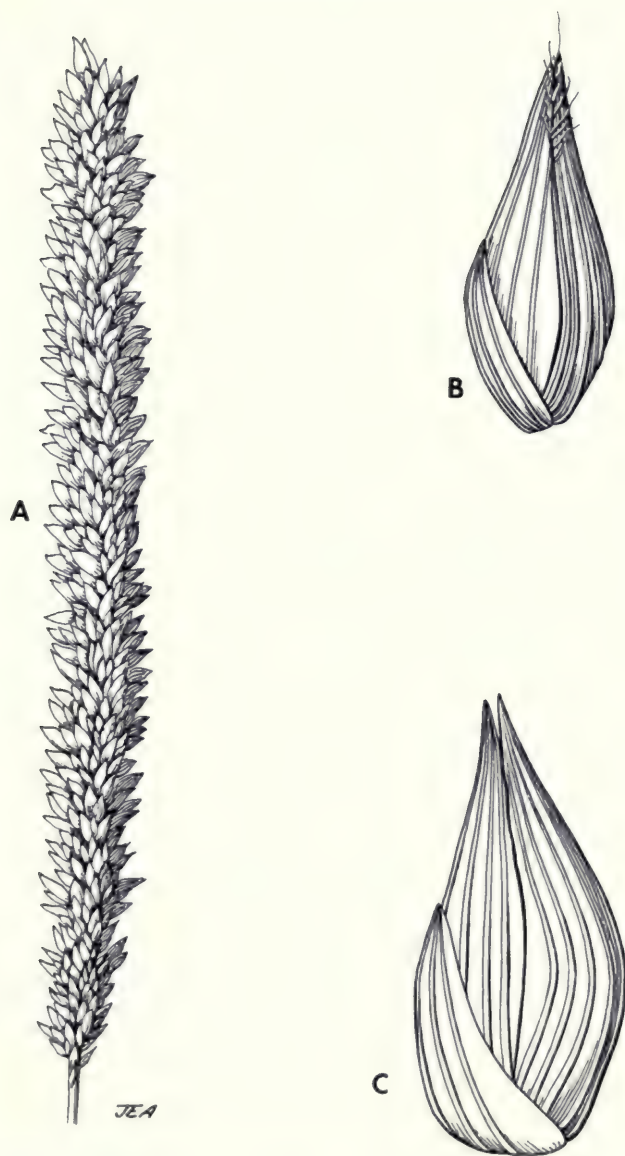


FIG. 195. *Sacciolepis* species. *S. myuros*: A, panicle; B, spikelet; *S. indica*: C, spikelet.

bases; branching from the base of the plants only; culms 15-50 cm. long, very slender, glabrous, the foliage mostly aggregated near the base; nodes glabrous; sheaths glabrous, shorter than the internodes; ligule a minute membrane, 0.1-0.3 mm. long; blades 3-10 cm. long, 2-4 mm. wide, glabrous. Peduncle very slender, 10-23 cm. long, often making up more than half of the height of the plant; panicles solitary, terminal, spikelike, 1.5-7.0 cm. long, usually less than 5 mm. thick, often purplish. Spikelets individually pedicellate on the rachis, densely overlapping and concealing it, biconvex, 2.5-2.8 mm. long; first glume 1.1-1.5 mm. long, ovate, boat-shaped, 5-nerved; second glume boat-shaped, narrowed to a blunt apex, 7-nerved, 2.5-2.8 mm. long; sterile lemma similar but more saccate at the base, 7-9-nerved, concealing a narrow stiff palea ca. 1 mm. long; fertile floret 1.5 mm. long, narrowly ovate, acute, smooth and shining, nerves obscure; palea ca. as long as the lemma; anthers 3, 0.6-0.9 mm. long, purple. Chromosome number $n = 9$ from Costa Rican specimens.

Wet pastures, lawns, ditches, riverbanks; mostly on the Caribbean slope; Meseta Central; elevations from 50-1,700 m. June to February, probably yearlong. Native to southeastern Asia and the Islands of the South Pacific; introduced in Africa, southeastern United States, and Central America.

Sacciolepis myuros (Lam.) Chase, Proc. Biol. Soc. Wash. 21:7. 1908. *Panicum myuros* Lam., Tabl. Encycl. 1:172. 1791. Figure 195.

Probably perennial; plants erect, tufted, 20-50 cm. tall; culms thick, somewhat succulent, sometimes with prop roots from lower nodes; prophyllum thin, brownish, to 2.5 cm. long; culms glabrous, hollow, thin-walled; nodes glabrous; sheaths overlapping, glabrous; ligule a thin brownish membrane, 1.0-2.5 mm. long; blades 15-25 cm. long, 2-5 mm. wide, glabrous beneath, sparsely and weakly pubescent above. Peduncles slender, erect, glabrous, exserted up to 18 cm.; inflorescence a dense cylindrical spikelike panicle, 4-18 cm. long, 5-8 mm. thick, the branches few-flowered, erect and appressed to the rachis, concealed by the densely overlapping spikelets. Spikelets biconvex, 2.0-2.2 mm. long; first glume 0.9-1.2 mm. long, ovate, blunt, convex, 3-nerved; second glume and sterile lemma similar, 2.0-2.2 mm. long, boat-shaped, the sterile lemma more saccate near the base, both 7-nerved, softly ciliate on the upper third; sterile lemma with a stiff, narrow palea ca. half as long as the lemma; fertile floret 1.0-1.2 mm. long, concealed by the glumes and sterile lemma, dorsally compressed, smooth and shining; lemma narrowly ovate, acute, the palea similar, both obscurely nerved; anthers 3, 0.5-0.7 mm. long, purple. Chromosome number $n = 18$ from Costa Rican material.

Rare, streams and marshes in savannas, south of LaCruz, Guanacaste. Elevations 200-250 m.; October to January. Southern Mexico to Honduras; Costa Rica; Panama; Colombia to Guyana and Brazil; Cuba.

SCHIZACHYRIUM Nees

REFERENCES: S. T. Blake, Taxonomic and nomenclatural studies in the Gramineae, No. 1, Proc. Roy. Soc. Queensland 80:6:55-84. 1969. S. T. Blake, Revision of the genera *Cymbopogon* and *Schizachyrium* (Gramineae) in Australia, Contr. Queensland Herb. 17:1-70. 1974. S.

Hatch, A biosystematic study of the *Schizachyrium cirratum*-*S. sanguineum* complex, Unpubl. Ph.D. Diss., Texas A.&M. Univ. 112 pp. 1975. G. V. Nash, *Schizachyrium*, in N. Amer. Flora 17:2:100-109. 1912. G. Roberty, Monographie systématique des Andropogonées du globe, Boissiera 9:1-455. 1960.

Perennial or annual grasses of small or moderate stature; inflorescences usually several to many per culm, terminal and axillary; individual inflorescence a solitary rame on a bracted peduncle; rame consisting of several-many pairs of spikelets, each pair borne at the base of a disarticulating rachis internode and falling attached to it; rachis internodes narrow at the base and thickened upward, the apex being obliquely cup-shaped and hollow, often with pointed appendages on the edges; pedicels similar but thinner. One spikelet of each pair sessile, perfect-flowered, and usually awned, the other spikelet borne on a pedicel attached at the base of the internode and reduced, sterile, or rudimentary, awned or awnless. Terminal segment of the rachis bearing a single sessile spikelet and 2 pedicellate ones. Sessile spikelets: Glumes subequal, firm, as long as the spikelet and completely concealing the inner parts, the awn protruding at the tip; first glume dorsally flattened, slightly convex, the 2 principal nerves at the lateral folds of the glume, sometimes prolonged into points at the apex; midrib absent, but weak nerves sometimes present between the 2 main ones; margins of first glume sharply inflexed, clasping the edges of the second glume; second glume keeled, boat-shaped, about as long as the first; lower (sterile) lemma hyaline; upper (fertile) lemma hyaline, awned between 2 prominent acuminate lobes; awn exerted, geniculate.

The genus is related to *Andropogon* and is sometimes regarded as a subgenus or section of it. It differs in having a single rame on each peduncle. Other related genera, sometimes included with *Schizachyrium* in *Andropogon*, are *Bothriochloa*, *Diectomis*, *Euclasta*, *Hyparrhenia*, and *Hypogynium*. Blake indicates that *Schizachyrium* includes 60-70 species, mostly from warm climates in both eastern and western hemispheres. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Schizachyrium*

- 1a. Rachis of rames straight, spikelets appressed to it; rachis glabrous or pubescent; anthers 3 2
- 1b. Rachis of rames strongly flexuous, spikelets standing out from it; rachis and pedicels conspicuously silky-ciliate with long hairs; anther 1 *S. microstachyum*
- 2a. Leaf blades 3.5 cm. or less long, parallel-sided, rounded abruptly to a blunt tip; dwarf annuals; sessile spikelets 2.0-3.5 mm. long; anthers less than 0.6 mm. long *S. brevifolium*
- 2b. Leaf blades up to 20 cm. long, tapering, the tip acute or acuminate; tufted perennials; sessile spikelets at least 4.5 mm. long; anthers over 1.5 mm. long . 3
- 3a. Leaf blades 1-3 mm. wide, acuminate; first glume of sessile spikelet flat on the back, glabrous; pedicellate spikelet ca. as long and wide as sessile one *S. tenerum*
- 3b. Leaf blades 3-5 mm. wide, acute; first glume of sessile spikelet convex, margins inrolled; back glabrous or pubescent; pedicellate spikelet reduced, much shorter than sessile one *S. hirtiflorum*

***Schizachyrium brevifolium* (Swartz) Nees ex Büse in Miq. Pl.**

Jungh. 359. 1854. *Andropogon brevifolius* Swartz, Prodr. Veg. Ind. Occ. 26. 1788. An extensive synonymy is given by S. T. Blake. Figure 196.

Caespitose annual, the culms weak, becoming decumbent and rooting at the lower nodes; branching abundant from the lower nodes; plants producing numerous axillary inflorescences, 1-5 peduncles arising from most of the middle and upper nodes; culms 4-60 cm. long; internodes less than 1 mm. thick, hollow, oval in cross section, glabrous, usually reddish; nodes glabrous; leaf sheaths keeled, longer or shorter than the internodes, glabrous, reddish; ligule a thin white membrane, 0.3-0.7 mm. long; leaf blades oblong, 1.0-3.5 cm. long, 1-4 mm. wide, glabrous; base of blade rounded to a minute pseudopetiole; apex rounded abruptly to a broad blunt tip; blades flat but keeled beneath, especially toward the apex. Inflorescences terminal on the main culms and from numerous leaf axils, the peduncles included or exserted from the leaf sheaths, bearing bladeless sheaths that subtend and usually include the base of the solitary rame; 1-5 peduncles arising from one leaf axil; rames 1.0-2.5 cm. long, consisting usually of 5-8 spikelet pairs; internodes narrow at the base, widened upward, very thin, the one side convex, the other hollowed out; pedicels similar to the rachis internodes but narrower; apex of each internode obliquely cup-shaped, with 2 points on the edges; base of the sessile spikelet partially hidden by the cup-shaped rachis apex. Sessile spikelets 2.0-3.5 mm. long, narrowly ovate 4.5-6.0:1, acute, dorsally flattened; callus short-bearded with straight erect white hairs; first glume as long as the spikelet, firm-textured, slightly convex on the back, scabrous, with 2 lateral keels near the apex that are prolonged into erect points; glume nerveless between the keels or with several weak nerves; second glume slightly shorter, strongly keeled, 1-nerved, scabrous on the keel; lower (sterile) lemma hyaline, nearly as long as the upper lemma; upper (fertile) lemma hyaline, nerveless, bifid almost to the base, the awn inserted in the cleft; first segment of the awn strongly twisted, brown, mostly included within the glumes, then geniculate, the upper segment white, straight, the exserted portion 5-7 mm. long; lodicules 2, truncate; anthers 3, purple, 0.4-0.6 mm. long. Pedicellate spikelets much reduced, with a short straight awn.

Most of our specimens have glabrous rachis internodes and pedicels, and hence belong to var. *brevifolium*. Two specimens, one from Hacienda Murcielago and another from the Liberia area, have ciliate rachis internodes and pedicels. This variant has been described as var. *flaccidum* (A. Rich.) Stapf, Fl. Trop. Africa 188. 1917 (*Andropogon flaccidus* A. Rich., Tent. Fl. Abyss. 2:452. 1851).

Curatella-Byrsonima savannas, tuff outcrops, dry volcanic slopes, steep road cuts. Common in Guanacaste, occasional in western parts of the Meseta Central; Boruca savannas; elevations 100-1,150 m.; absent from moister areas and from the Caribbean slope. Mexico to Brazil; West Indies; widespread in the tropics of Africa and Asia and the islands of the western Pacific. Germination of the seeds occurs during the rainy season, but the plants remain vegetative until late October. Blooming November to January.

Schizachyrium hirtiflorum Nees, Agrost. Bras. 334. 1829. *An-*



FIG. 196. *Schizachyrium* species. *S. brevifolium*: A, blooming culm; B, seedlings in vegetative condition; *S. microstachyum*: C, compound inflorescence of several rames.

dropogon hirtiflorus (Nees) Kunth, Rév. Gram. 1:Suppl. XXXIX. 1830. *S. semiberbe* Nees, Agrost. Bras. 336. 1829. *A. semiberbis* (Nees) Kunth, Rév. Gram. 1:Suppl. XXXIX. 1830.

Caespitose perennial in small tufts; plants 90-150 cm. tall, erect; culms branching from the middle and upper nodes; internodes elongated, glabrous, elliptical in cross section, solid, 1.5-2.8 mm. thick; leaf sheaths keeled, shorter than the internodes, glabrous; ligule a minutely erose membrane, 0.8-1.0 mm. long, leaf blades flat, up to 19 cm. long, 3-5 mm. wide, keeled beneath, scabrous above at the base, otherwise glabrous. Peduncles several to many, terminal and axillary from the middle and upper nodes, mostly included in bladeless sheaths; rames solitary on each peduncle, the base mostly included in the terminal sheath, 3-13 cm. long, slender, straight; rachis internodes 6-8 mm. long, convex on the back, thickened upward, the oblique basal callus upwardly bearded; apex obliquely cup-shaped; pedicels similar to the rachis internodes but thinner, 5.0-6.5 mm. long, ciliate along one margin; rachis internodes and pedicels glabrous or more or less pubescent on the back. Sessile spikelets: 5.8-7.8 mm. long, including the basal callus of the internode; outline ovate 6-10:1, acute; first glume as long as the spikelet, convex on the back, the margins incurved; apex bifid; second glume about as long, keeled, 1-3-nerved; lower (sterile) lemma 4-5 mm. long, hyaline, often purplish; upper (fertile) lemma 4.0-4.5 mm. long, membranaceous, ciliate, very narrow, deeply divided into 2 acute lobes to the basal third; awn brown, tightly twisted below, geniculate, light-colored and straight above the bend, exerted ca. 10 mm.; palea absent; anthers 3, yellow, 1.5-2.0 mm. long; styles 2, separate; naked for the basal two-thirds; stigmas purple. Pedicellate spikelets: 2.5-4.0 mm. long, with an awn 1.0-3.5 mm. long; first glume flat, faintly nerved; second glume slightly shorter; florets usually lacking; one specimen had a well-developed lower lemma and 3 stamens. Chromosome number $n = 30$ from the single Costa Rican specimen.

Dry *Curatella-Byrsonima* savannas, coastal bluffs; from the Nicaraguan border to Cañas; sea level to 200 m. elevation; Boruca savannas; dry hillsides, Cantón de Dota, to 1,500 m. September to January. Florida and southwestern United States to southern South America.

A variety of chromosome numbers has been reported. Specimens display a continuous spectrum of pubescence patterns on the first glume of the sessile spikelet and the margins and surfaces of the rachis internodes and pedicels. For this reason, I have united *S. hirtiflorum* and *S. semiberbe* under the first name, which has page priority in Nees. Hatch has proposed submerging the American plants under *S. sanguineum* (Retz.) Alst., an Afro-Asian species originally described from Madagascar, a procedure previously adopted by Roberty.

Schizachyrium microstachyum (Hamil.) Ros., Arr. & Izag., Bol. Fac. Agron. Montevideo 103:35. 1968. *Andropogon microstachyus* Hamil., Prodr. Fl. Ind. Occ. 8. 1825. Figure 196.

Caespitose perennial in small tufts; plants 90-150 cm. tall, erect; culms simple below, becoming branched above into a compound inflorescence; internodes 2.0-3.5 mm. thick,

glabrous, oval in cross section, the interior filled with white or pinkish pith; nodes glabrous, not prominent; leaf sheaths keeled, glabrous or rarely obscurely puberulent, the lower ones longer than the internodes, the upper shorter; ligule a firm membrane, 0.7-2.0 mm. long, adnate to the sheath margins; leaf blades up to 40 cm. long, 3-8 mm. wide, glabrous, flat but keeled beneath, occasionally with a few hairs at the throat. Culms becoming much-branched above, forming an elongated ovoid compound inflorescence, composed of numerous solitary rames borne on spatheolate peduncles; compound inflorescence 20-40 cm. long, 3-8 cm. wide, rather loose and feathery. Individual rames on slender branches, the base of each invested by an involute or flattened sheath (spatheole) which may conceal the lower spikelet pairs; spatheoles 15-35 mm. long; rames 25-60 mm. long, with up to 8 spikelet pairs; peduncle usually very short; rachis internodes 4-6 mm. long, widened upward, conspicuously ciliate on the edges, the cilia longest toward the cup-shaped apex; pedicels similar but more slender, 3.6-5.5 mm. long. Sessile spikelets: Callus blunt, minutely bearded, hidden by the hollow apex of the rachis internode; spikelet 4.5-5.0 mm. long, narrowly ovate ca. 10:1, acute; glumes about equal, as long as the spikelet, the first slightly convex on the back, with 2 submarginal keels, the edges inflexed over the margins of the second glume, the apex slightly bidentate; second glume slightly shorter, 1-nerved, strongly keeled, the keel scabrous; lower (sterile) lemma acute, hyaline, ciliate on the margins, 3.2-3.8 mm. long; upper (fertile) lemma hyaline, strongly 2-lobed to the insertion of the awn near the base, lobes acute, ciliate; awn dark brown and strongly twisted below, the exerted portion above the bend straight or loosely twisted, ca. 10 mm. long; palea absent; lodicules 2, truncate; anther 1, brown, ca. 1 mm. long; styles 2, separate; stigmas dark; caryopsis linear-cylindrical, 2.5-2.8 mm. long, amber. Pedicellate spikelet: Abortive, usually 1-2 mm. long, with a straight awn to 2 mm. long. Terminal sessile spikelet accompanied by 2 pedicellate spikelets. Chromosome number $n = 10$ from Costa Rican and Salvadorian specimens.

Occasional; *Curatella-Byrsonima* savannas, steep road embankments; regions of La Cruz and San Ramón; Nuestro Amo, Las Conchas, Navarro, Turrialba, Siquirres. Elevations 250-1,100 m. August to March. *Schizachyrium microstachyum* is a member of a species complex that ranges from Mexico to Argentina. Our specimens belong to ssp. *elongatum* (Hack.) Rosengurt, loc. cit. which possesses an elongate and rather loose inflorescence. In this subspecies, the spatheoles may often be flattened rather than closely convolute. Specimens with such flattened spatheoles may have a conspicuously different appearance from those in which the spatheoles are rolled.

Central American plants have often been included in *S. condensatum* (H.B.K.) Nees, but are now assigned to *S. microstachyum* by South American agrostologists.

***Schizachyrium tenerum* Nees, Agrost. Bras. 336. 1829. *Andropogon tener* (Nees) Kunth, Rév. Gram. 565. 1832.**

Perennial, in dense tufts; culms 40-110 cm. long, erect or reclining, branching from the base or rather sparingly from middle nodes; internodes slender, 1.0-1.5 mm. thick, hollow, glabrous; nodes glabrous, not prominent; lower leaf sheaths overlapping, the

upper ones shorter than the internodes, glabrous, slightly keeled; ligule a thin membrane, 0.5-0.7 mm. long; leaf blades narrow, 1.0-2.5 mm. wide, flat, up to 25 cm. long, keeled beneath, the uppermost one much reduced; midrib broad, whitish; upper surface scabrous near the base and sometimes with a few elongated papillose-based hairs. Peduncles exserted 3-5 cm., slender; inflorescences terminal and axillary from the upper leaf axils; rames slender, 3-10 cm. long, the spikelets appressed to the straight rachis; internodes of the rachis 3.8-4.5 mm. long, thick, rounded on the back, hollow, the inner surface grooved, membranaceous; apex strongly obliquely cup-shaped; base of internode bearded; pedicels narrower, about as long as the internodes. Sessile spikelets: 4.5-5.0 mm. long, ovate 5-6:1, acute; first glume convex, firm and light-colored near the base, greenish and striate above with ca. 7 weak nerves; apex bidentate; margins inflexed over the edges of the second glume; second glume strongly keeled, scabrous on the keel, faintly 3-nerved; lower (sterile) lemma 3.2-4.0 mm. long, flattened, membranaceous, 2-nerved near the margins, lacking a palea or a flower; upper (fertile) lemma 3.5-4.0 mm. long, narrow, hyaline, divided to the middle into ciliate, acuminate lobes, the awn arising between them; awn exserted ca. 10 mm., with a brown, strongly twisted first segment, geniculate, the upper segment straight; palea absent; anthers 3, yellow, ca. 2 mm. long. Pedicellate spikelets: Somewhat similar to the sessile ones and about as long, 4.7-5.2 mm. long, awnless or awn-tipped; first glume convex, ca. 7-nerved; second glume keeled, ca. as long as the first; florets absent.

Known in Costa Rica only by the following specimens: Cartago, 5 km. E of Paraíso, elevation 1,130 m., savanna remnant, 1 November 1968, *P. & D. 11394*; Puntarenas, 5.3 km. N of Buenos Aires by road, elevation 470 m., open savanna, 10 October 1968, *P. & D. 11243*. Southeastern United States, Mexico and Guatemala, Panama to Argentina; West Indies.

SECALE Linnaeus

Vigorous caespitose annual cereal grass; culms unbranched; inflorescence a solitary erect terminal spike, the spikelets solitary, densely imbricated in 2 rows on opposite sides of the persistent rachis. Spikelets 2-flowered; glumes narrow, much shorter than the florets, awnless; lemmas strongly keeled, the tips long-awned, the midrib bearing a row of short, rigid bristles; rachilla prolonged above the palea of the second floret as a naked bristle; grains cylindrical, falling free from the florets when mature. (Pooideae: Triticeae).

Secale cereale L., *Sp. Pl.* 84. 1753.

This European species is widely cultivated as a grain crop in cold climates. It has been cultivated for forage on the volcanoes of the Meseta Central, but is not common. It may persist in old fields after cultivation at upper elevations. Common names *centeno* or "rye."

SETARIA Beauvois

REFERENCE: J. M. Rominger, 1962. Taxonomy of *Setaria* (Gramineae) in North America. Illinois Biol. Monogr. 29:VIII + 132.

Annual or perennial, caespitose or rhizomatous grasses; inflorescence a spike-like or rarely open panicle; some or all of the spikelets subtended by one or more bristles (sterile branches), these either antrorsely or retrorsely barbed. Spikelets disarticulating below the glumes, dorsally compressed and flat on the first glume side, more or less convex on the second glume side; first glume much shorter than the spikelet, usually deltoid and 1-3-nerved; second glume shorter than or subequal to the spikelet in length, 5-7-nerved; lower (sterile) lemma about as long as the spikelet, 5-7-nerved, often with a well-developed palea about equal to it in length, sometimes containing a staminate flower or a caryopsis; glumes and lower lemma membranaceous, or rarely the lemma stiff; upper (fertile) floret with a coriaceous or rigid, convex, often corrugated awnless lemma, its margins covering the edges of a flat or concave palea of equal length and similar texture; keels of the palea usually prominent, protruding as ridges; stamens 3; style branches naked below; caryopsis elliptical, flattened, with a large embryo.

Setaria is a genus of ca. 125 species of grasses of temperate and tropical regions of both eastern and western hemispheres. Some species are important weeds of croplands; *S. italica* is a minor crop plant ("millet"); several are used as ornamentals for their peculiar plicate leaves. The common species are readily recognizable by their bristly, cylindrical inflorescences and typically panicoid spikelets. The genus is closely related to *Pennisetum*, from which it differs by the disarticulation of the spikelets above the attachment of the bristles of the fascicles. Some authors include in *Setaria* the species regarded by Hitchcock as belonging to *Panicum*, subgenus *Paurochaetium*. These species have a bristle subtending only the terminal spikelet of each branch. *Ixophorus*, which occurs in Central America, also has a single bristle accompanying each spikelet, but the spikelets at maturity have an enlarged and protruding palea in the lower floret. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Setaria*

- 1a. Leaf blades elliptical, longitudinally corrugated, usually 3-10 cm. wide 2
- 1b. Leaf blades linear or narrowly lanceolate, not corrugated, up to 3 cm. wide ... 3
 - 2a. Lower panicle branches 6-25 cm. long, panicles rather open, green
S. paniculifera
 - 2b. Panicle branches, except lowermost, usually less than 5 cm. long; panicle dense, often purplish *S. poiretiana*
- 3a. Each spikelet or spikelet group subtended by 5-10 yellow bristles, edges of sheaths thin, translucent, glabrous 4
- 3b. Each spikelet subtended by 0-3 greenish bristles; sheath edges ciliate 5
 - 4a. Panicles 1-8 cm. long; plants usually less than 1 m. tall; anthers purple, 0.8 mm. or less long; wild plants. *S. geniculata*
 - 4b. Panicles 8-25 cm. long; plants 1-2 m. tall; anthers tan, 1.4 mm. or more long; cultivated crop plants *S. anceps*
- 5a. Spikelets disarticulating only below glumes; fertile lemma rugose; lower floret never producing caryopsis 6

- 5b. Spikelets disarticulating below glumes or below fertile floret; fertile lemma smooth and shining, not rugose; lower floret often producing a caryopsis *S. magna*
- 6a. Bristles bearing upwardly pointing (antrorse) barbs only 7
- 6b. Bristles bearing both antrorse and backwardly pointing (retorse) barbs 8
- 7a. Rachis of panicle scabrous; sterile lemma lacking palea *S. liebmannii*
- 7b. Rachis of panicle bearing elongated fine hairs; sterile lemma enclosing palea of equal length *S. vulpiseta*
- 8a. Spikelets 2.3-2.6 mm. long; sterile lemma enclosing palea of equal length; antrorse and retrorse barbs intermixed along length of bristles *S. tenax*
- 8b. Spikelets 1.4-1.8 mm. long; palea of sterile lemma absent or small; retrorse barbs borne only on upper half of bristles 9
- 9a. Sterile lemma lacking palea; bristles bearing retrorse barbs on the upper half; panicles up to 20 cm. long *S. tenacissima*
- 9b. Sterile lemma with palea ca. half as long; panicles usually 10 cm. or less long; bristles bearing only few retrorse barbs at the very tip *S. scandens*

***Setaria anceps* Stapf ex Massey, Sudan Grasses 33. 1926.**

Perennial from hard crowns; short rhizomes present; culms erect or the bases decumbent, up to 2 m. tall, with 5-10 nodes; internodes glabrous, compressed, hollow but thick-walled; sheaths keeled, longer than the internodes, glabrous, their margins glabrous, thin and translucent; ligule a thin membrane, crowned by a dense row of white hairs, in total 1.5-2.5 mm. long; dewlap conspicuous, colored; blades flat, glabrous, up to 45 cm. long and 13 mm. wide; base of blade scabrous-puberulent behind the ligule. Inflorescence a solitary terminal panicle on a long-exserted glabrous peduncle; panicle densely cylindrical, 8-25 cm. long, ca. 1 cm. thick, including the yellow bristles; spikelets densely crowded in small fascicles, concealing the rachis; each spikelet or spikelet group subtended by a cluster of 5-10 yellow, stiff, antrorsely scabrous bristles. Spikelets ovate 2.5:1, 2.4-2.8 mm. long; first glume 1.2-1.3 mm. long, narrowly ovate; second glume 1.5 mm. long, narrowly ovate, acute, 3-5-nerved; lower (sterile) lemma as long as the spikelet, 5-nerved, thin, enclosing a palea of similar length and shape and a staminate flower; anthers 3, tan, 1.6-1.7 mm. long; upper (fertile) floret ca. 2.3 mm. long; lemma ovate, strongly rugose except at the mucronate tip; palea equal, with conspicuous keels; anthers 3, 1.4-1.5 mm. long, tan; styles separate; stigmas purple.

This African species has been cultivated in the grass garden of the CATIE at Turrialba and is now being cultivated in the Sarapiquí area. I have seen fields near Cariblanco, La Virgen, and Aguas Zarcas. This species belongs to the *S. sphacelata* complex, which is a group displaying much morphological and cytological diversity. Some of the species are discussed by W. D. Clayton in Kew Bull. 20:262-264. 1966.

***Setaria geniculata* (Lam.) Beauv., Ess. Nouv. Agrost. 51, 178. 1812. *Panicum geniculatum* Lam., Encycl. 4:727. 1798. For an extended synonymy, see Hitchc., N. Amer. Fl. 17:320. 1931. Figure 197.**

Perennial, caespitose from a hard, knotty crown or short rhizomes; culms 30-120 cm. long, erect or sometimes decumbent and even rooting at lower nodes, branching from lower and middle nodes; culms 2 mm. thick, hollow, glabrous; ligule a ring of stiff hairs, less than 1 mm. long; blades flat, up to 25 cm. long, 2-10 mm. wide, glabrous or with a

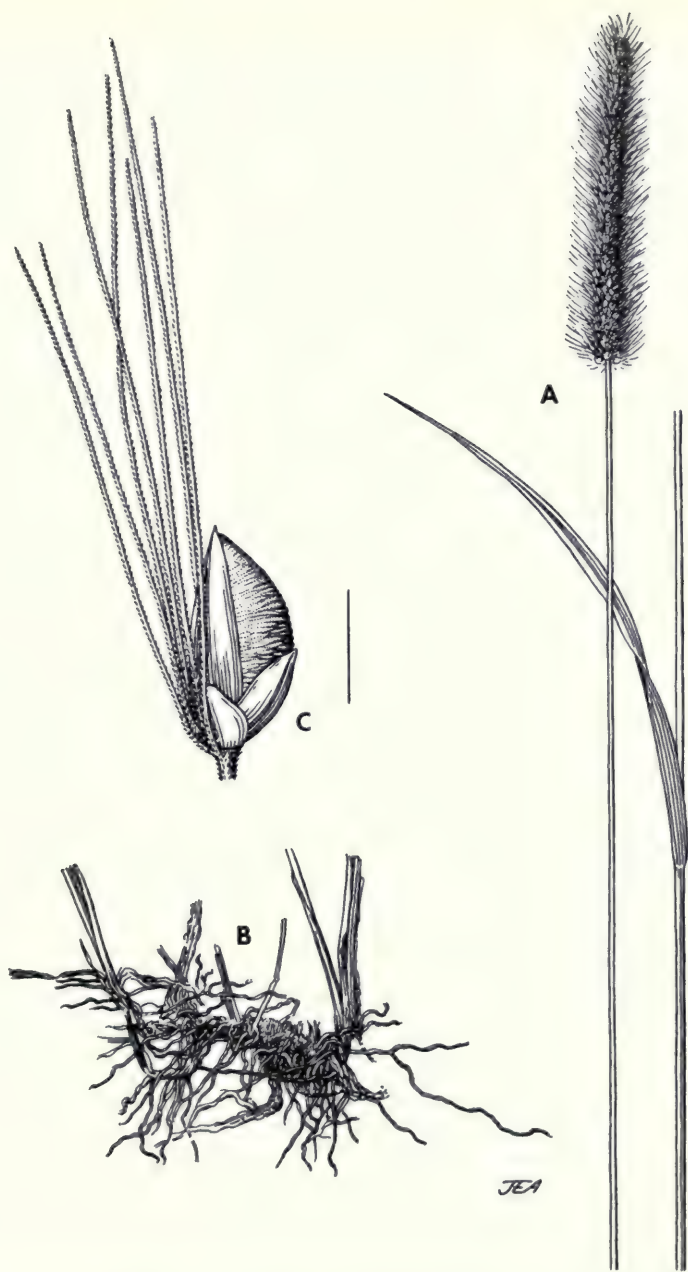


FIG. 197. *Setaria geniculata*. A, panicle; B, rhizomatous base; C, spikelet with fascicle of sterile branches.

few long hairs on the upper surface at the base. Peduncle glabrous, scabrid and grooved at the tip, 5-32 cm. long; inflorescence a dense, spikelike panicle, 1-8 cm. long, up to 2.5 cm. thick, including the yellow or bronzy bristles; bristles clustered, 4-12 below each spikelet, antrorsely scabrous, 2-15 mm. long; rachis minutely pubescent; spikelets solitary or often 2 together on a short branchlet. Spikelets elliptical, 2.0-2.8 mm. long, color greenish or often purple at the tip or overall; first glume deltoid, 0.8-1.0 mm. long, 3-4-nerved; second glume 1.1-1.4 mm. long, 5-nerved, much shorter than the fertile lemma; lower (sterile) lemma about as long as the spikelet, usually herbaceous, 5-7-nerved, sometimes grooved along the midrib and somewhat coriaceous and slightly rugose, its palea about as long as the lemma; anthers 3, purple, 0.6-0.8 mm. long; upper (fertile) floret rigid, ovate 2:1, the lemma strongly convex, strongly rugose, often purple at the acute tip; palea equal, rugose, concave, the keels forming prominent ridges, the marginal flanges wide, enveloping the base of the caryopsis; anthers 3, purple; caryopsis elliptical 3:2, whitish, the embryo over half the length. Chromosome number $n = 18$ from Costa Rican specimens. Other chromosome counts of $n = 36$ are known from elsewhere.

Widespread and common, from sea level to 1,800 m. elevation; roadsides, lawns and pastures, grassy wet pond margins, savannas. Probably blooming yearlong, but with a flowering peak in the rainy season. Widespread in the western hemisphere, from about 40 degrees N lat. in the United States to Argentina.

This species displays a bewildering variety of aspects, depending particularly on the length and color of the bristles and the color of the spikelets. Rominger (1962) has discussed this variation and concluded that no clearly separable entities are to be found in the complex. Hitchcock (1931) gives a voluminous synonymy. The status of the name is somewhat questionable, since Beauvois (1812) in describing the genus *Setaria*, did not indicate that the species was based on *Panicum geniculatum* of Lamarck. Later authors have made the assumption that it was so based. If one rejects this assumption, then the name should be cited as *Setaria geniculata* Beauv.

***Setaria liebmannii* Fourn., Mex. Pl. 2:44. 1881.**

Caespitose annual; culms 30-120 cm. long, erect or the bases decumbent and rooting from the lower nodes, unbranched, or sometimes much branched from the lower nodes; culms up to 3.5 mm. thick, hollow, thin-walled, glabrous; nodes sparsely appressed bearded, or the upper glabrous; leaf sheaths glabrous except for the minutely bearded overlapping margin; collar short-hispid; ligule a dense row of silky white hairs, 1.5-2.0 mm. long; leaf blades flat, lax, 5-25 cm. long, 4-24 mm. wide, scabrous on the surfaces; margins with a cartilaginous white band. Peduncle exserted, glabrous, scabrous near the apex; inflorescence solitary, terminal on the main culm or on leafy branches, cylindrical, tapering to base and apex, 5-20 cm. long, 2-3.5 cm. wide, including the greenish yellow bristles; with short, ascending branches up to 2 cm. long; rachis scabrous, somewhat exposed between branches; spikelets racemose along the branches, up to about 10 per branch, some of them abortive, each accompanied by a single antrorsely scabrous bristle, these 7-17 mm. long. Spikelets ovate 5:3, glabrous, 2.3-2.7 mm. long; first glume deltoid, 3-nerved, 0.8-1.0 mm. long; second glume ovate, 1.9-2.2 mm. long, with 5 main

nerves and 2 inconspicuous lateral ones; lower (sterile) lemma as long as the spikelet, 2.3-2.7 mm. long, with 5 main nerves and 2 inconspicuous lateral ones; palea and flower lacking; upper (fertile) floret 2.0-2.3 mm. long, ovate 5:3, lemma blunt-apiculate, rigid, the middle third of the length strongly rugose with ca. 10 coarse transverse ridges; palea rugose, as long as the lemma, with strongly ridged keels; lodicules 2, truncate; stamens 3, the anthers 1.2-1.3 mm. long, orange. Chromosome number $n = 9$ from a Costa Rican specimen.

Rare; low elevations, on sea cliffs and savannas; known from Playas del Coco, Mata de Limón, and Finca la Pacifica. July and August. Southern Arizona to Costa Rica, mostly on the Pacific slope.

***Setaria magna* Griseb., Fl. Brit. W. Ind. 554. 1864.**

Tall, robust annual; culms up to 4 m. tall and 2 cm. thick, hollow, glabrous; leaf sheaths shorter than the internodes, keeled, glabrous, the overlapping margin short-ciliate; ligule an inverted V-shaped line, a short membrane bearing a dense row of stiff white hairs, in total up to 3.5 mm. long; blades flat, scabrous, up to 50 cm. long and 35 mm. wide. Peduncle exserted, scabrous; inflorescence dense, cylindrical, lobulate, 15-70 cm. long, 3-5 cm. thick, including the bristles; rachis densely pilose; spikelets numerous, borne on short overlapping lateral branches, each subtended by 1-3 antrorsely scabrous bristles. Spikelets 2.0-2.3 mm. long, elliptical or obovate 2:1, disarticulating below the glumes but also freely above the sterile lemma, the mature fertile floret drooping; first glume broadly deltoid, 3-nerved, 0.8-1.0 mm. long; second glume slightly shorter than the spikelet, 1.8-2.2 mm. long, 7-nerved; lower lemma as long as the spikelet, 5-7-nerved, with a well-developed palea of equal length, frequently containing a flower and developing a naked caryopsis; upper (fertile) floret elliptical 2:1, 1.8 mm. long, the lemma smooth and shining, not rugose, minutely longitudinally striate, faintly 5-nerved, the margins barely covering the edges of the flat palea; caryopsis rotund, 1 mm. long, whitish; anthers 0.5 mm. long.

This very tall species is found mostly in salt marshes of the Atlantic and Gulf Coasts of the United States and in the Greater Antilles. It has also been collected in the Yucatan. The only Costa Rican collection is *Pittier 6825*, collected in March 1892, which carries labels indicating that it is from Boca Zacate or Punta Mala. These two localities are over 15 km. apart. It may be that this species was introduced by accident, and it probably does not currently occur in Costa Rica.

***Setaria paniculifera* (Steud.) Fourn., Mex. Pl. 2:42. 1881. *Panicum paniculiferum* Steud., Syn. Pl. Glum. 1:54. 1853.**

Perennial in large clumps or colonies; culms 1-4 m. tall, unbranched, erect or the bases decumbent; internodes compressed, up to 7 mm. thick, hollow, thick-walled, glabrous or slightly appressed-hispid below the nodes; nodes glabrous or appressed-hispid; leaf sheaths overlapping, keeled, more or less papillose-hispid, especially on the overlapping margin; collar bearing an external ligule of stiff, glassy hispid hairs, up to 2 mm. long; internal ligule a minute membrane tipped with a dense row of short hairs, up to 2 mm. long, sometimes with longer hairs on the upper blade surface adjacent to it; leaf blades strongly plicate, narrowly ovate, tapering to a petiole-like base and an acute tip; nerves diverging from the midrib; length up to 60 cm.; width to 10 cm.; surfaces scabrous and

with scattered glassy hispid hairs. Peduncle exserted, ridged, bearded at the apex; inflorescence a large open terminal panicle with diverging or drooping branches; rachis and branches angular, scabrous; length up to 60 cm.; lower branches 15-35 cm. long, usually one to several long ones borne together with several short basal branches; spikelets borne racemosely along the primary branches or along short secondary branches; some of the spikelets, especially terminal ones, accompanied by slender, flexuous, antrorsely scabrous sterile branches, these up to 18 mm. long; pedicels 0.2-2.0 mm. long, appressed to the branches. Spikelets ovate 3.5:1, acuminate, glabrous, 3.2-3.8 mm. long; first glume 1.8-2.0 mm. long, ovate, acute, 3(4)-nerved; second glume ovate, acute, 5-nerved, 2.4-2.7 mm. long, shorter than the fertile lemma; lower (sterile) floret with an ovate, 5-nerved lemma 3.1-3.5 mm. long, equalling the fertile floret; palea absent or if present, 1.2-2.6 mm. long; no flower present; upper (fertile) lemma ovate, 3:1, acuminate, stiff, faintly 5-nerved, slightly rugulose on the back; palea equal to the lemma; lodicules 2, truncate; anthers 3, yellow or orange, 1.0-1.5 mm. long; caryopsis elliptical 2.5:1, white, flattened. Chromosome number $n = 17$ from Costa Rican specimens.

Occasional; riverbanks, moist open areas, roadsides, forest margins; from sea level to 800 m. elevation, on both Caribbean and Pacific slopes. Probably blooming yearlong. Southern Mexico to Panama, Colombia, and Venezuela; Caribbean Islands.

The plants are very conspicuous because of their large, corrugated leaf blades. The only similar grass in Central America is *S. poiretiana*.

Setaria poiretiana (Schult.) Kunth, Rév. Gram. 47. 1829. *Panicum poiretianum* Schult. in R. & S., Syst. Veg. Mant. 2:229. 1824. Figure 198.

Caespitose perennial; culms 1-3 m. tall, unbranched; internodes compressed, solid, 3.5-4.5 mm. thick, glabrous or hispid below the nodes; nodes appressed-hispid; sheaths mostly overlapping, keeled, papillose-hispid with stiff, glassy hairs; collar hispid; ligule a short thick membrane, crowned with a dense fringe of hispid hairs, in total 1.5-3.0 mm. long; blades elliptical, up to 70 cm. long, 3-5 cm. wide at the middle, strongly plicate, the nerves diverging from the midrib; base narrow, petiole-like, up to 10 cm. long; apex long-caudate; surfaces sparsely hispid, scabrous near the tip. Peduncle exserted, grooved, hispid-bearded at the apex; inflorescence a solitary, terminal, narrowly cylindrical panicle, tapering to a narrow apex, 35-70 cm. long, 7-15 cm. wide near the base; rachis grooved, scabrous; branches mostly ascending or the lowermost drooping; lower branches 5-8 cm. long, borne in remote partial verticels, spikelet-bearing to their bases; rachis plainly exposed between adjacent verticels; upper branches shorter and more or less overlapping and concealing the rachis; spikelets secund, very shortly pedicellate along the primary branches or on short secondary branches; pedicels 0.2-0.5 mm. long; some of the spikelets, especially the terminal ones, subtended by solitary slender, flexuous bristles, these antrorsely scabrous and 10-15 mm. long. Spikelets 3.0-3.7 mm. long, ovate 3:1; first glume ovate, blunt, 3-nerved, 1.7-1.8 mm. long; second glume ovate, blunt, 5-8-nerved, 2.0-2.4 mm. long, reaching about to the middle of the fertile lemma; lower (sterile) lemma 3.0-3.5 mm. long, slightly shorter than the tip of the fertile lemma, membranaceous, 5-nerved; palea absent or oblong, up to 2.5 mm. long; upper (fertile) floret ovate, acuminate, 2.9-3.5 mm. long; lemma stiff, very faintly rugulose, acuminate, faintly 5-nerved, the palea as long and similar in texture; lodicules 2, truncate; anthers 3, yellow to orange, 1.4-2.0 mm. long; caryopsis elliptical 2:1, 2 mm. long, brownish; embryo ca. half the length.



FIG. 198. *Setaria poiretiana*. A, panicle; B, leafy culm with plicate leaf blades; C, branchlet with spikelets and sterile branches (bristles).

This species is known from Central America only by the following specimen: Cartago, 3 km. S of Tres Rios, along sewerage ditch in cafetal, 1,300 m., *Pohl 12782*, 2 April 1972. Southern Mexico; northern South America to Argentina; Caribbean Islands.

This species bears a strong resemblance to *S. paniculifera*, differing in the much narrower panicle and more caudate leaves. Previous descriptions indicate that the sterile lemma lacks a palea or has a rudimentary one. Our specimen has a well-developed palea, but is otherwise very similar to *Pringle 3921* from Mexico cited by Rominger as belonging to this species.

Setaria scandens Schrad., in Roem. & Schult., Syst. Veg. Mant. 2:279. 1824.

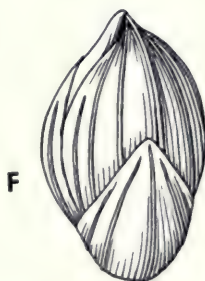
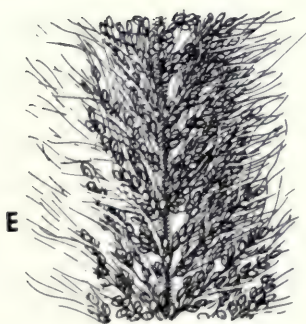
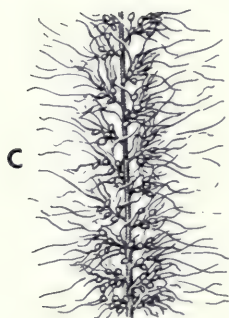
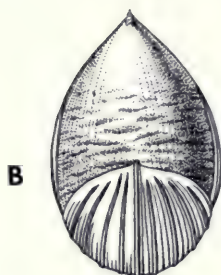
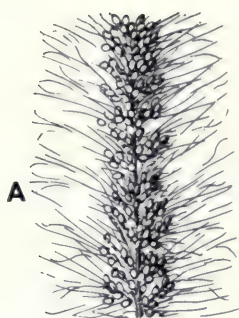
Caespitose annual; culms 20-80 cm. tall, erect, branching from the base and lower nodes; prophylla prominent, 2-3 cm. long; internodes hollow, thin-walled, glabrous; nodes glabrous or bearded below the edge of the sheath; leaf sheaths keeled, shorter than the internodes, more or less papillose-pilose, especially along the margins; upper sheaths mostly glabrous; ligule a dense row of hairs, 0.5-1.0 mm. long; blades flat, thin, 5-16 cm. long, 7-16 mm. wide, widest at the middle, tapering to a narrow base. Peduncles slender, papillose-pilose or glabrous, up to 15 cm. long; inflorescence terminal on the main culm or on leafy branches; panicles narrowly cylindrical, dense, 3-6 cm. long, less than 1 cm. thick, including the bristles; rachis scabrous and with scattered long pilose hairs that protrude between the spikelets; branches very short, few-flowered; 1-3 stiff, undulate bristles borne below each spikelet; bristles 3-5 mm. long, strongly antrorsely scabrous except at the tip, where a few retrorse barbs occur. Spikelets very strongly plano-convex, the depth about equal to the width, 1.5-1.8 mm. long; first glume broadly deltoid, faintly 3-nerved; second glume broadly ovate, 1.4-1.7 mm. long, 5-nerved, shorter than the fertile lemma; lower (sterile) lemma 1.5-1.8 mm. long, equalling the fertile floret, 5-nerved, its palea a narrow, nerveless scale one-third to one-half as long as the lemma; upper (fertile) lemma 1.3-1.6 mm. long, rigid, strongly rugose except near the tip, strongly boat-shaped, the depth equalling the width; palea equal to the lemma, rigid, longitudinally striate; anthers tan, 0.5 mm. long.

Rare or overlooked; San Juan (Tibas), Las Juntas. August to November. Southern Mexico to Panama; Caribbean Islands; South America to Paraguay.

This species is similar in general aspect to the temperate zone *S. viridis* (L.) Beauv., from which it differs in bristle number and the retrorse terminal barbs.

Setaria tenacissima Schrad., in Roem. & Schult., Syst. Veg. Mant. 2:279. 1824. Figure 199.

Annual, caespitose, 1-2 m. tall, the culms unbranched or branching from lower nodes; culms 2-3 mm. thick, hollow, glabrous; nodes glabrous; sheaths glabrous, keeled, rather loose; ligule a dense ring of stiff white hairs, ca. 1 mm. long; blades flat, 10-22 cm. long, 4-13 mm. wide, pilose on both sides. Inflorescence solitary, terminal, the peduncle ex-



JE-A

FIG. 199. *Setaria* species. *S. tenax*: A, panicle; B, spikelet; *S. tenacissima*: C, panicle; D, two views of a spikelet; *S. vulpiseta*: E, panicle; F, spikelet.

serted, glabrous, grooved, scabrous at the apex; panicle cylindrical, rather stiff, 5-20 cm. long, 1-3 cm. wide, including the stiff bristles; branches 3-5 mm. long, bearing several spikelets; bristles 10-17 mm. long, stiff, the lower half upwardly barbed, the apical half retrorsely barbed. Spikelets elliptical 5:3, strongly plano-convex, becoming purple when mature, 1.4-1.6 mm. long; first glume broadly ovate, blunt, 3-nerved, ca. 0.7 mm. long; second glume slightly shorter than the spikelet, 5-nerved, exposing the back of the fertile lemma only at the tip; lower (sterile) lemma as long as the spikelet, 5-nerved, lacking palea or flower; upper (fertile) floret slightly shorter than the sterile lemma; lemma very strongly convex, its stramineous surface rugose with numerous fine transverse ridges on the lower two-thirds; palea flat, similar in texture; anthers 3; caryopsis elliptical 4:3, whitish, strongly plano-convex.

Rare or overlooked in Costa Rica; in brush. Blooming December to February. Elevations 800-1,200 m. Cañas Gordas, San Ramón, La Guacima, Río Tiliri. Guatemala to Brazil and Bolivia; Caribbean Islands.

Setaria tenax (L. Rich.) Desv., Opusc. 78. 1831. *Panicum tenax* L. Richard, Actes Soc. Hist. Nat. Paris 1:106. 1792. Figure 199.

Caespitose perennial, forming hard, knotty crowns; culms 50-200 cm. tall, erect, branching from the base; internodes 2-3 mm. thick, hollow but thick-walled, glabrous; nodes narrow, impressed; sheaths usually longer than the internodes, keeled toward the apex, glabrous or pilose, the overlapping edge ciliate; collar appressed-hispid; ligule a short membrane, long-ciliate with a dense row of stiff hairs, in total 0.7-3.0 mm. long; blades flat, narrow at the base, up to 32 cm. long, 7-22 mm. wide, scabrous or pilose. Peduncle sparsely pilose or glabrous, exserted; inflorescence solitary, terminal on the culms, cylindrical, 5-20 cm. long, 2-3 cm. thick, including the flexuous bristles; rachis densely pilose with spreading hairs; branches up to 6 mm. long, the spikelets densely crowded, 5-10 per branch; bristles up to 15 mm. long, covered with intermixed retrorse and antrorse barbs. Spikelets 2.3-2.6 mm. long, ovoid 3:2, very strongly convex on the fertile lemma side, the sterile lemma side usually somewhat inflated as well; first glume 1.0-1.4 mm. long, broadly ovate, 3-5-nerved; second glume ca. half as long as the spikelet, 1.5-1.8 mm. long, 7-9-nerved, ovate, blunt, exposing much of the back of the fertile lemma; lower floret sterile, the lemma nearly as long as the spikelet, 2.1-2.4 mm. long, ovate, nerves 5 or 5 plus 2 weak lateral ones; palea as long as the lemma; upper (fertile) floret 2.2-2.4 mm. long, lemma elliptical 3:2, nerves 5, faint, tip mucronate; lower two-thirds of lemma transversely rugose; palea equal to the lemma, rugose; lodicules 2, truncate; anthers 3, dark, 0.6-1.2 mm. long; caryopsis rotund 7:6, white, strongly plano-convex.

Occasional at altitudes up to 280 m. in Guanacaste; roadsides, river banks, or in brush. July to August. Southern Mexico to Paraguay and Argentina; West Indies.

Setaria vulpiseta (Lam.) Roem. & Schult., Syst. Veg. 2:495. 1817. *Panicum vulpisetum* Lamarck, Encycl. Meth. 4:735. 1798. Figure 199.

Caespitose perennial, the culms arising from hard crowns, up to 2 m. tall, erect, branching from the base; internodes compressed, up to 6 mm. thick, hollow but thick-walled, glabrous or slightly appressed-pilose below the narrow, impressed nodes; leaf sheaths keeled, mostly longer than the internodes, more or less appressed-pilose, especially the overlapping margin; collar bearing an external ligule, composed of a short

membrane bearing a dense ring of stiff hairs, in total ca. 3 mm. long; internal ligule similar; leaf blades thin, flat, very narrow at the base, widened at the middle, scabrous, especially toward the tip, up to 60 cm. long and 35 mm. wide. Inflorescences solitary, terminal, borne on exserted peduncles; larger panicles 25-33 cm. long, cylindrical, rachis densely pilose with spreading hairs, somewhat open, 4-6 cm. thick, including the yellowish bristles, the branches ascending, up to 2.5 cm. long, bearing small clusters of spikelets on secondary branches; bristles 10-15 mm. long, antrorsely scabrous, the tip truncate. Spikelets 2.4-2.6 mm. long, ovate 5:3; first glume ovate, broad, 1.0-1.5 mm. long, 3-5-nerved; second glume 1.9-2.0 mm. long, usually 7-nerved; lower floret sterile, the lemma as long as the spikelet, bluntly mucronate, 5-nerved, containing a palea of equal length; upper (fertile) floret 2.2-2.3 mm. long, ovate 5:3, the lemma strongly rugose on the lower two-thirds, bluntly mucronate; lodicules 2, truncate; anthers 3, brown, 0.7-1.0 mm. long; style branches naked below.

Roadsides and brushy areas at low elevations; occasional in the southern General Valley, Turrubares, Colonia Carmona, Siquirres. August to February. Southern Mexico to Panama, Venezuela, Peru, and Argentina; Caribbean Islands.

SORGHASTRUM Nash

Perennial or annual grasses; inflorescence a terminal panicle of short rames, each consisting of 1-several internodes, each node bearing a sessile, perfect-flowered spikelet accompanied by a slender hairy pedicel and a similar hairy rachis internode; pedicellate spikelet almost always absent, rarely a minute rudiment present; disarticulation at the base of each internode, the spikelet, internode, and pedicel falling as a unit. Spikelets dorsally compressed, ovate; callus blunt, bearded; glumes equal, coriaceous, entirely covering and concealing the delicate florets; lower (sterile) lemma hyaline, nerveless, ciliate on the upper margins; upper (fertile) lemma similar, bifid at the tip, the awn arising between the ciliate teeth, its base forming the broad white midrib of the lemma; lodicules 2, truncate or forked at the apex; anthers 3; stigmas 2, laterally exserted from the spikelets; awn exserted from the glumes, twisted and geniculate.

Sorghastrum is similar to *Sorghum* in possessing a panicle of short rames bearing awned sessile spikelets, but differs in lacking staminate pedicellate spikelets, the pedicels being naked at the tip or rarely with a minute rudiment. About 20 species in warm climates of the Americas and Africa. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Sorghastrum*

- 1a. Awns very conspicuous, 2-4 cm. long; weak caespitose or sprawling annual
S. incompletum
- 1b. Awns not conspicuous, less than 1 cm. long, usually exserted less than length of spikelet; tall perennial in dense tufts *S. setosum*

Sorghastrum incompletum (Presl) Nash, N. Amer. Fl. 17:130. 1912. *Andropogon incompletus* Presl, Rel. Haenk. 1:342. 1830. Figure 200.

Tufted annual, 25-90 cm. tall, the plants erect, or sprawling and rooting at lower



FIG. 200. *Sorghastrum* species. *S. incompletum*: A, inflorescence; B, spikelets with sterile pedicels and rachis internodes; *S. setosum*: C, rame with two spikelets.

nodes, branching freely from the base and lower nodes; culm internodes glabrous, solid and pithy or hollow; nodes contracted, slightly appressed-hispid; sheaths glabrous or occasionally papillose-hispid; ligule a stiff brown membrane, 0.5-1.7 mm. long; leaf blades up to 28 cm. long, 8 mm. wide, rounded abruptly to a narrow base. Peduncle included or exerted up to 10 cm.; inflorescence solitary, terminal, cylindrical, loose to usually compact, 5-15 cm. long, diameter 2-3 cm., the awns very conspicuous; branches thin and delicate, flexuous, usually glabrous except at the base of the rames, which consist of 1-3 internodes, each bearing a sessile spikelet; internodes of the rachis and pedicels slender, two-thirds as long as the spikelet, heavily bearded with stiff white hairs. Spikelets dorsally compressed, ovate 4:1; callus blunt, bearded with white hairs; first glume flat on the back, 5-7-nerved, more or less hispid, the margins narrowly incurved over the edges of the second, tip narrowly truncate, ciliate; second glume convex on the back, slightly keeled, glabrous, 3-nerved, slightly longer than the first glume; lower (sterile) lemma thin and membranaceous, nerveless, oblong, truncate, 2.5-3.0 mm. long, the upper margins ciliate; upper (fertile) lemma membranaceous, very narrow, forming a narrow margin along the sides of the flattened awn-base, the tip 2-lobed, ciliate; anthers 3, 1.0-1.3 mm. long, brown. Pedicellate spikelets are usually lacking, but rarely a minute rudimentary one occurs. Chromosome number $n = 10$ from a Costa Rican specimen; $n = 20$ reported from Venezuela.

Open savannas at low elevations, 100-380 m. elevation. Liberia area, Nicoya, Boruca. December to January. Mexico to Venezuela and Colombia; Africa.

Sorghastrum setosum (Griseb.) Hitchc., Contr. U.S. Natl. Herb. 12:195. 1909. *Andropogon setosus* Griseb., Cat. Pl. Cuba 235. 1866. Figure 200.

Perennial; caespitose in large, dense clumps; culms 1-2 m. tall, unbranched, glabrous, solid or with a small lumen, up to 3 mm. thick; nodes not prominent, appressed-bearded with short erect white hairs; internodes elongated; sheaths glabrous; ligule a stiff brown membrane, 1.5-3.5 mm. long, its margin adnate to the sheath apex; leaf blades up to 50 cm. long, 5-7 mm. wide, widest at the middle, tapering to a narrow base; uppermost blades much reduced. Peduncle included in the uppermost sheath or exerted up to 15 cm., glabrous; inflorescence a solitary terminal panicle of rames, narrowly cylindrical, loose or rather dense, 20-32 cm. long; branches thin and delicate, ascending. Rames of 2-6 internodes and spikelets; internodes and sterile pedicels ca. two-thirds as long as the spikelets, heavily bearded with spreading stiff white hairs. Spikelets all alike, 3.5-5.6 mm. long, sessile, ovate 4-5:1, acute, the callus blunt, bearded; glumes golden brown, the first sparsely to densely bearded with stiff, spreading white hairs, flat on the back, 7-9-nerved, its margins incurved and covering the edges of the second glume; second glume as long as the first, convex, slightly keeled, glabrous, 5-nerved; lower (sterile) lemma 3.0-4.2 mm. long, oblong, with a slightly bifid tip, hyaline, nerveless, its upper margins ciliate; upper (fertile) lemma 2.7-4.0 mm. long, narrowly triangular, its upper margins ciliate, bifid at the tip into 2 triangular lobes, the awn arising between them; awn twisted and geniculate, exerted about the length of the spikelet, or very short and not twisted; lodicules 2, truncate or slightly lobed at the tip; anthers 3, yellow, ca. 2.5 mm. long. Chromosome number $n = 10$ from the Costa Rican specimen.

Known in Costa Rica only by the following specimen: Guanacaste, Hacienda Murcielago Road at CIA, elevation 300 m. *Pohl & Erickson*

12650, 26 July 1971. Open marshy areas. Southern Mexico to Honduras, southern Nicaragua and northwestern Costa Rica; Venezuela to Argentina; West Indies.

This species is similar to the common *S. nutans* (L.) Nash of temperate North America, but differs in the smaller spikelets, weaker awns, and apparently different chromosome number. Our specimen is a close match for material distributed by the U.S. National Herbarium as *S. agrostoides* (Speg.) Hitchc., Amer. Grasses Natl. Herb. 278.

SORGHUM Moench

REFERENCE: J. D. Snowden, The cultivated races of *Sorghum*, Adlard. London. 274 pp. 1936.

Plants annual or perennial, caespitose or rhizomatous; inflorescence a much-branched terminal panicle of short rames, these consisting of several internodes, each bearing a pair consisting of a sessile, perfect-flowered, usually awned fertile spikelet, accompanied by an awnless staminate or sterile pedicellate one; terminal segment of each rame bearing a single sessile spikelet accompanied by 2 pedicellate ones; rachis disarticulating at the base of each internode, the sessile and pedicellate spikelets falling as a unit with the rachis internode and pedicel, or the pedicellate spikelet deciduous. Sessile spikelets: Dorsally compressed; glumes stiff and rigid, ovate, entirely enclosing and concealing the delicate florets (except in strains cultivated for grain); first glume flat or slightly convex, many-nerved, its margins slightly inflexed over the edges of the second; second glume similar, convex or keeled, several-nerved; lower (sterile) lemma thin, hyaline, nerveless, ciliate, longer than the second; upper (fertile) lemma hyaline, nerveless, the apex strongly 2-lobed, the awn arising between the ciliate lobes, not continued to the base of the lemma; palea minute or lacking; lodicules 2, thick and fleshy, broadly truncate, the apex ciliate; anthers 3; styles 2, the plumose stigmas laterally exerted from the spikelets; caryopsis broadly elliptical or subspherical, in cultivated grain strains bursting from the glumes. Pedicellate spikelets: Soft-textured; glumes ca. equal in length, the first flat on the back with submarginal narrow keels, 5-7-nerved; second glume boat-shaped, usually 5-nerved, its margins incurved, ciliate near the apex; sterile lemma hyaline, faintly nerved or nerveless, the upper margins inflexed, ciliate; fertile lemma shorter than the sterile one, ciliate, awnless; lodicules 2, broadly truncate, the apex ciliate; flower staminate or absent; anthers 3; ovary absent; palea absent or minute.

Sorghum is native to the Old World, presumably originating in Africa, but widely distributed in warm climates of the eastern hemisphere. The genus has ca. 50 species, but numerous hybrid forms are in cultivation. In the western hemisphere, the genus is represented by numerous cultigens and several weedy rhizomatous perennials. The genus is closely related to the American genus *Sorghastrum*, from which it differs in having rames that possess well-developed, usually staminate, pedicellate spikelets. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Sorghum*

1a. Tall, slender, strongly rhizomatous perennial; caryopsis remaining concealed within

- glumes; occasional weed *S. halepense*
 1b. Coarse, maizelike plants; annuals; rhizomes absent; caryopsis large, subspherical in
 some strains and bursting from glumes *S. bicolor*

***Sorghum bicolor* (L.) Moench, Meth. Pl. 1:207. 1794. *Holcus bicolor* L., Mant. Alt. 301. 1771. *Sorghum vulgare* Pers., Syn. Pl. 1:101. 1805.**

This species is here construed to include all of the common cultivated annual sorghums, with the exclusion of Sudan grass. The plants are so variable as to preclude writing a botanical description to include all of them. Usually the plants have thick, maizelike stems, and in vegetative condition, much resemble maize seedlings. The culms are usually thick and maizelike, and the leaf blades are very wide and resemble those of maize. Plant height is extremely variable, some dwarf grain strains being only 1 m. tall, whereas tall forage strains may be as much as 5 m. tall. The inflorescences vary from very dense in some grain strains to very loose and lax. Spikelet color varies from stramineous to red, deep purple, or black. In some strains, the grains are small and contained within the glumes, whereas in grain strains, the caryopses may burst the glumes open. In general, the spikelets do not disarticulate spontaneously, remaining on the inflorescence until threshed. Africa, but now cultivated in all warmer and drier parts of the world. Chromosome number $n = 10$.

The following general groups of sorghums may be recognized, although modern plant breeding has combined traits of many of these:

1. Grain sorghums. These have enlarged caryopses and are cultivated as a substitute for maize, especially in dry climates. Some modern strains are dwarf and suited for mechanical harvesting of the grain.
2. Sweet sorghums. The stems are juicy and sweet, and are fed to livestock or are crushed for syrup. The grain is usually inferior.
3. Broomcorn. In this strain, the main axis of the panicle is very short, and the lateral branches slender and elongated. The dried panicles are used in the manufacture of brooms and brushes, and plants are often seen growing around houses.

***Sorghum halepense* (L.) Pers. Syn. Pl. 1:101. 1805. *Holcus halepensis* L., Sp. Pl. 2:1047. 1753. Figure 201.**

Tall erect perennial; culms erect, arising from extensive scaly rhizomes; culms unbranched, to 2 m. tall, glabrous, solid, the interior pithy; nodes constricted, appressed-hispid; sheaths shorter than the internodes, glabrous or often pubescent on the collar; ligule a stiff membrane, 3-6 mm. long, appressed-pubescent on the back and ciliate at the apex; leaf blades flat, narrow at the base, widest at the middle, up to 66 cm. long and 3.5 cm. wide; midrib broad, white; edges of blades not scabrous. Peduncle exerted up to 20 cm., glabrous; inflorescence solitary, terminal, narrowly pyramidal, open, up to 40 cm. long, usually ca. one-third as wide; branches whorled, ascending, up to 13 cm. long, naked near the base, the pulvini pubescent; spikelets borne in short rames of 1-5 pairs, mostly on second-order branches, appressed to the branches; internodes and pedicels ca. one-half as long as the sessile spikelets, flattened and ciliate; disarticulation at the base of each internode and at the apex of the pedicels, the summits of the internodes and pedicels cup-shaped. Sessile spikelets: Ovate 2:1, 4-6 mm. long, acute, stramineous, more



FIG. 201. *Sorghum halepense*. Inflorescence, rhizomatous base, two views of a spikelet pair, showing sessile and pedicellate spikelets.

or less appressed-hispid; glumes stiff and rigid; first glume slightly convex, faintly 9-nerved, the margins narrowly inflexed over the edges of the second; second glume boat-shaped, faintly 5-7-nerved, its margins ciliate above; lower (sterile) lemma hyaline, narrowly ovate, faintly nerved, 3.8-4.5 mm. long, its margins ciliate; upper (fertile) lemma ovate, 2-lobed, ciliate, the awn absent or up to 1.5 cm. long, twisted and geniculate, arising between the lobes; palea absent or a minute nerveless ciliate scale; lodicules 2, truncate, ciliate; anthers 3, yellow, 2.0-2.6 mm. long; stigmas purple. Pedicellate spikelets: 4.0-5.7 mm. long, texture herbaceous; first glume flattened, ovate 2.5:1, acute, 6-9-nerved; second glume boat-shaped, 5-7-nerved; lower lemma 3.8-4.5 mm. long, narrowly ovate, hyaline, faintly nerved; upper (fertile) lemma 2.5-3.5 mm. long, awnless; palea absent; anthers 3, yellow, 2.0-2.5 mm. long. Chromosome number $n = 20$.

Rare or occasional in Costa Rica; Nicoya, Siquirres, Limón, Las Concavas, San José. May to November. Johnson grass, which is a bad weed in warm temperate climates, seems to barely maintain itself in Costa Rica. The earliest collection was an 1895 Pittier specimen from Siquirres. In 1908, it occurred in the cemetery at Guadalupe and was brought from there to an experimental field. It now occurs as a casual weed on the campus of the university, but does not appear to be particularly aggressive. This species originated in the Old World, possibly in the Mediterranean area, but is now widespread in warm climates of the world. Common names: *Zacate de Johnson*, "Johnson grass."

Awns of the sessile spikelets are very easily deciduous, and many spikelets of a panicle may lack them at maturity. In other plants, none are apparently produced.

Sorghum sudanense (Piper) Stapf, commonly known as "Sudan grass," is a caespitose annual closely resembling *S. halepense*. It lacks rhizomes, and the rachis internodes and pedicels break irregularly, leaving jagged ends, rather than disarticulating regularly as in *S. halepense*. Sudan grass may at times occur as a cultivated crop, although I have never seen it in Costa Rica.

SPARTINA Schreber

Perennial, usually rhizomatous grasses; culms unbranched; inflorescence of 1-many 1-sided spikes. Spikelets flat, strongly laterally compressed and keeled, subsessile, densely imbricated in 2 rows along the lower sides of the triquetrous rachis; disarticulation below the glumes; glumes strongly keeled, longer or shorter than the single floret; first glume 1-nerved, the second 1-3-nerved; lemma awnless, firm, 1-3-nerved; palea about equalling the lemma, 2-nerved.

Spartina is a genus of ca. 17 species of perennial grasses, most of them being native to salt marshes or less commonly to interior grasslands. The genus has been variously placed and has no obvious close relatives. (Chloridoideae: Chlorideae.)

Spartina spartinae (Trin.) Hitchc., Contr. U.S. Natl. Herb. 17:329. 1913. *Vilfa spartinae* Trin., Mém. Acad. Imp. Sci. St.-Petersbourg, Sér. 6, Sci. Math, Seconde Pt. Sci. Nat. 4:82. 1840. Figure 202.

Perennial, forming dense hard clumps; culms up to 200 cm. tall, erect; rhizomes absent; culms glabrous, solid, the interior filled with pith; sheaths glabrous, mostly overlapping; ligule an arc of hairs, 1-2 mm. long; blades 12-125 cm. long, 1.5-4 mm. wide, firm, involute, strongly ridged and scabrous above, scabrous on the margins, glabrous below; inflorescence 6-70 cm. long, a terminal raceme of 6-75 one-sided spikes; individual spikes 0.5-7 cm. long, stiff and erect. Spikelets 10-60 per spike, 4-10 mm. long; first glume 2-8 mm. long, 1-nerved; second glume 4-8 mm. long, apparently 1-nerved, narrowly lanceolate, scabrous on the keel; lemmas narrowly ovate, blunt-tipped or apiculate, scabrid on the keel, 5-6 mm. long; palea ca. equal to the lemma; anthers 3, yellow or purple, 3-5 mm. long. Chromosome number $n = 20$ from Costa Rican fixations.

Rare, coral beaches around Limón, Uvita, Piuta. The clumps are very firmly attached to the rock. Our specimens were collected in September, but the blooming season may be much longer. Florida to Texas, Mexico, British Honduras, Costa Rica; Paraguay and Argentina.

Other recent reports indicate that the chromosome number of $n = 20$ is correct, although earlier investigations listed a basic chromosome number of $x = 7$ for this genus.

SPOROBOLUS R. Brown

REFERENCES: W. D. Clayton, Studies in the Gramineae: VI. Sporoboleae. The *Sporobolus indicus* complex, Kew Bull. 19:287-295. 1965. P. Jovet & M. Guédès, Le *Sporobolus indicus* (L.) R. Br. var. *fertilis* (Steud.) Jov. et Guéd. naturalisé en France, avec une revue du groupe du *Sporobolus indicus* dans le monde, Bull. Centr. Études Rech. Sci. 7(1):47-75. 1968; and Validation of names in *Sporobolus*, Taxon 22:163. 1973.

Annual or perennial caespitose or rhizomatous grasses. Inflorescence a panicle. Spikelets small, 1-flowered; glumes equal or unequal, usually shorter than the floret, 1-nerved or nerveless; disarticulation above the glumes, or more commonly the spikelet remaining intact, the seed being extruded from the split ovary wall; lemma awnless, 1-nerved; palea ca. equal to the lemma or slightly longer, often splitting between the nerves when mature; mature ovary usually swelling and becoming gelatinous when wetted, splitting and extruding the adhesive seed.

A large genus of temperate zone and tropical grasses of both eastern and western hemispheres. The spikelets in this genus are similar to those of *Muhlenbergia*, differing in the faintly nerved lemmas and total absence of awns, as well as in the free pericarp of the grain. (Chloridoideae: Sporoboleae.)

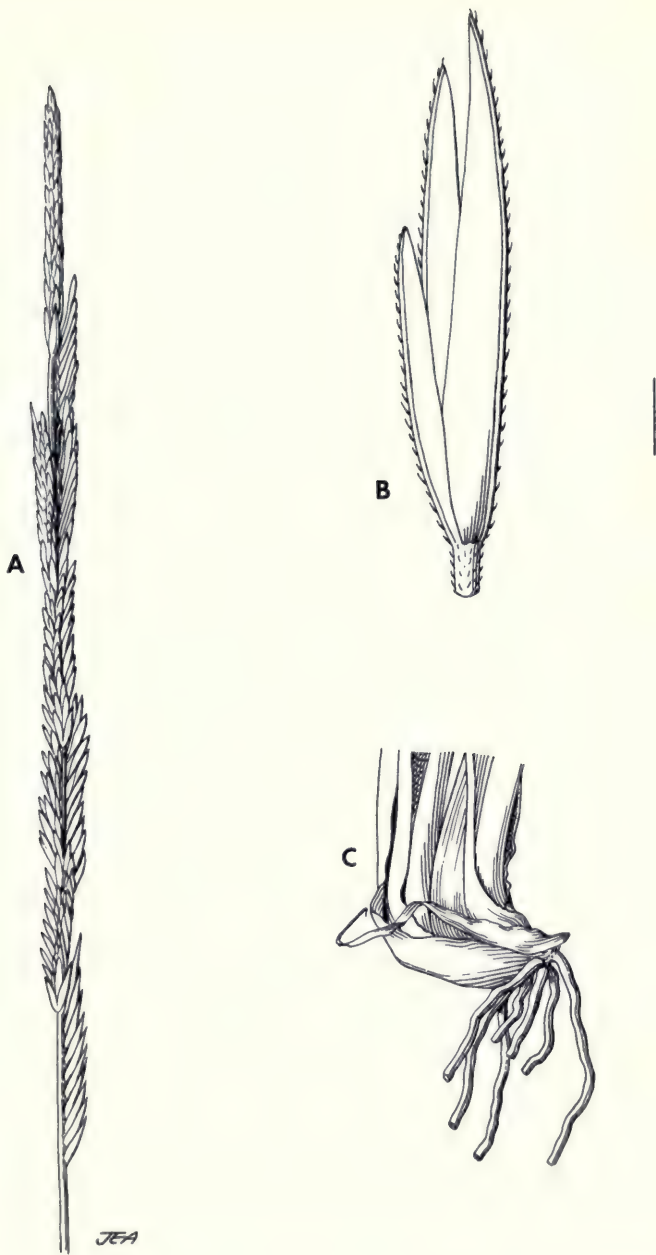


FIG. 202. *Spartina spartinae*. A, inflorescence; B, spikelet; C, caespitose culm base.

KEY TO SPECIES OF *Sporobolus*

- 1a. Strongly rhizomatous plants; foliage harsh and wiry; beaches along the Caribbean near Limón *S. virginicus*
- 1b. Caespitose plants without rhizomes; foliage various; not confined to sea beaches . 2
 - 2a. Panicle pyramidal or open-cylindrical, not more than 3 × longer than wide; branches spreading, whorled, naked at bases 3
 - 2b. Panicle narrowly cylindrical or spikelike, more than 5 × longer than wide; branches erect and appressed, spikelet-bearing to their bases 4
- 3a. Spikelets more than 3 mm. long, purple; panicle open-cylindrical *S. cubensis*
- 3b. Spikelets less than 2 mm. long, grayish; panicle pyramidal *S. pyramidatus*
 - 4a. Leaf blades conspicuously papillose-ciliate 5
 - 4b. Leaf blades not papillose-ciliate 6
- 5a. Spikelets chestnut-brown, less than 2 mm. long *S. ciliatus*
- 5b. Spikelets leaden-gray, 2.9 mm. or more long *S. purpurascens*
 - 6a. Spikelets less than 2 mm. long; culm internodes hollow; nodes less than 0.5 mm. high; inflorescence lax; plants of low elevations *S. jacquemontii*
 - 6b. Spikelets over 2 mm. long; culm internodes solid; nodes 1-2 mm. high; inflorescence dense and strict; plants of middle elevations *S. indicus*

***Sporobolus ciliatus* Presl, Rel. Haenk. 1:242. 1830. Figure 203.**

Caespitose in small tufts, 10-35 cm. tall; apparently annual; culms erect, branching from the base and lower nodes, glabrous, sometimes glandular-spotted near the nodes; prophylla up to 20 mm. long; nodes glabrous, contracted; foliage mostly near the base of the plants, the upper internodes much longer than the lower; sheaths mostly ca. as long as the internodes, papillose-ciliate on the margins; ligule a minute ciliate fringe, ca. 0.3 mm. long; blades firm, flat, cordate-based, 1.5-6.5 cm. long, 2.0-4.5 mm. wide, conspicuously papillose-ciliate on the margins, often with scattered papillose-based hairs on the surfaces; uppermost blade usually much reduced. Peduncle exerted up to 3 cm.; inflorescences solitary, terminal on the main culms or on leafy basal branches; panicles slender, 2-9 cm. long, ca. 5 mm. wide, the erect verticillate branches less than 1 cm. long, densely flowered to the base. Spikelets reddish brown, biconvex, 1.8-2.0 mm. long, V-shaped and gaping when mature; first glume narrowly lanceolate or deltoid, 0.6-0.7 mm. long, nerveless or 1-nerved; second glume ovate, 1.6-1.7 mm. long, 1-nerved; lemma ovate, 1-nerved, 1.7-1.9 mm. long; palea ca. equal to the lemma but much broader, splitting between the nerves when mature, the caryopsis discharged between the split halves; anthers yellow, 0.6-0.7 mm. long; grain oval, 1.0-1.2 mm. long, the ovary wall gelatinizing when wet and discharging the elliptical laterally flattened white seed. Chromosome number $n = 27$ from Costa Rican material.

Rare, hilly savannas at Boruca; collected in 1893 and again in 1968. August to November. Honduras to Panama and Brazil.

***Sporobolus cubensis* Hitchc., Contr. U.S. Natl. Herb. 12:237. 1909. Figure 203.**

Perennial, in dense tufts; plants 50-70 cm. tall, erect; foliage aggregated at the base of the plants; basal sheaths short, heavily pilose on the margins; basal blades very elongated, up to 60 cm. long, 3-4 mm. wide, glabrous except for a few long hairs on the lower margins; upper surface prominently ridged; blades usually folded or involute; culm



FIG. 203. *Sporobolus* species. *S. ciliatus*: A, panicle; B, spikelet; *S. cubensis*: C, panicle; D, spikelet.

blades much reduced. Inflorescence a solitary terminal panicle, 8-15 cm. long, 2-4 cm. wide, the branches whorled or solitary, perpendicular to the rachis; spikelets borne near the tips of the spreading branches and appressed to them, short-pedicellate. Spikelets purplish, 3.1-4.0 mm. long; first glume ovate, acute, 1.6-2.2 mm. long, obscurely nerved; second glume 3.2-3.9 mm. long, ovate, acute, faintly 1-nerved; floret 2.8-4.0 mm. long, the lemma ovate, acute, rounded on the back, faintly 1-nerved; palea equal to the lemma or slightly longer, faintly 2-nerved, often splitting between the nerves at maturity; anthers 3, purplish, 2.0-2.4 mm. long; caryopsis ca. two-thirds as long as the spikelet, obovate, rounded at the apex; ovary wall gelatinizing when wet.

This species has been collected only once in Costa Rica, from the savannas of Cañas Gordas at 1,100 m. elevation. February. Cuba and Puerto Rico; northern South America; Belize and northeastern Nicaragua.

Sporobolus indicus (L.) R. Br., Prodr. Fl. Nov. Holl. VI:170. 1810. *Agrostis indica* L., Sp. Pl. 63. 1753. *Sporobolus poiretii* (R. & S.) Hitchc., Bartonian 14:32. 1932. Figure 204.

Perennial, in dense clumps; plants 55-95 cm. tall, erect; culms unbranched, 1.0-3.5 mm. thick, glabrous; nodes prominent, 1-2 mm. long; internodes solid, pithy; sheaths glabrous except for the ciliolate upper margin; ligule a minute ciliolate fringe, 0.1-0.3 mm. long; blades glabrous, flat, 13-35 cm. long, 3-5 mm. wide. Peduncle exserted 1-16 cm.; inflorescence solitary, terminal, a dense spikelike cylindrical panicle, 15-33 cm. long, 0.5-3.0 cm. thick (mostly less than 1 cm.); branches 1-4 cm. long, erect and appressed, densely covered with overlapping short-pedicellate spikelets. Spikelets grayish, laterally compressed, 2.1-2.7 mm. long, usually not disarticulating, the seed at maturity extruded from the gelatinizing caryopsis and emerging from the floret at its apex; glumes unequal, the first a rounded nerveless scale, 0.5-1.0 mm. long, erose at the apex, the second ovate, acute or rounded and erose at the apex, 0.9-1.5 mm. long, faintly one-nerved; floret longer than the glumes, the lemma ovate, acute, faintly 1-nerved, 2.1-2.5 mm. long, glabrous; palea similar but slightly shorter, faintly 2-nerved, 1.9-2.2 mm. long, glabrous; anthers 3, white, 0.5-1.0 mm. long; seed quadrate, truncate, brown, glistening. Inflorescences frequently become smutted when the seeds are extruded. Chromosome number $n = 18$ from a Central American specimen.

Common in open areas, roadsides, and pastures; middle elevations, 300-1,900 m., most common above 1,000 m. June to December; probably blooming yearlong. Southeastern United States to Ecuador and Paraguay; West Indies.

This species and *S. jacquemontii* are very similar, but occupy distinct ecological niches. The taxonomy of the group is confused, and it is unlikely that a final disposition of its members could be made without intensive biosystematic study. The papers cited above, by Clayton (1965) and Jovet and Guédès (1968), offer an introduction to the complexities. Common name: *Pitilla*.

Sporobolus jacquemontii Kunth, Rév. Gram. 2:427, t. 127. 1831. *Vilfa jacquemontii* (Kunth) Trin., Mém. Acad. Imp. Sci. St.-



FIG. 204. *Sporobolus indicus*. Panicle, blooming plant, spikelet, floret.

Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci Nat. 4:92. 1840.
Sporobolus indicus Am. Auth., non *Agrostis indica* L.

Perennial, caespitose, often in large circular clumps; plants 40-110 cm. tall, erect; culms unbranched, glabrous, 1-2 mm. thick; internodes hollow; nodes glabrous, shrunken, narrow, less than 0.5 mm. high; sheaths glabrous except for the minutely ciliate upper margins, shorter than the internodes; ligule a minutely ciliate fringe, 0.2-0.3 mm. long; blades glabrous, 12-30 (60) cm. long, 2-5 mm. wide, usually involute, ridged above, tapering to long, fine flexuous points. Peduncle exerted 6-16 cm.; panicle solitary, terminal, 13-25 cm. long, narrowly cylindrical but open, 1-3 cm. wide, the branches ascending or somewhat spreading, the lower ones often 3-5 cm. long. Spikelets grayish, rather densely clustered along the primary or short secondary branches, short-pedicellate, laterally compressed, 1.5-1.8 mm. long, usually not disarticulating, the seed at maturity extruding from the gelatinizing caryopsis and emerging from the floret at its apex; glumes subequal, usually less than half as long as the spikelet, obovate, blunt, erose, the first nerveless, 0.4-0.8 mm. long, the second faintly 1-nerved, 0.7-1.0 mm. long; floret 1.5-1.7 mm. long, glabrous, the lemma acute, faintly 1-nerved; palea ca. equal to the lemma; anthers 3, white, or purple-tinged, 0.9-1.1 mm. long; caryopsis ca. one-third shorter than the floret; seed quadrate, truncate at the apex, brown and glistening. The inflorescences may become smutted when the seeds are extruded. Chromosome number $n = 12$ from a Costa Rican specimen.

Common at low elevations in Costa Rica, mostly under 100 m.; beaches, pastures, roadsides, and open areas generally. June to February, probably blooming yearlong. Southeastern United States and the West Indies; Mexico to northern South America.

This species is very similar to the upland *S. indicus*, but occupies a different habitat. See discussion of the two under *S. indicus*. Common name: *Pitilla*.

***Sporobolus purpurascens* (Swartz) Hamil., Prodr. Pl. Ind. Occ. 5. 1825. *Agrostis purpurascens* Swartz, Prodr. Veg. Ind. Occ. 25. 1788.**

Caespitose; possibly perennial; plants 11-32 cm. tall, erect; culms branching from the base only, hollow, ca. 1 mm. thick, glabrous; foliage mostly basal, the culms with 1-3 leaves, the uppermost blade much reduced; sheaths glabrous except for the ciliate margins, longer than the internodes; ligule a row of stiff hairs, 0.7-0.8 mm. long; blades flat, firm, 4-19 cm. long, 3-5 mm. wide, broad-based, the margins conspicuously papillose-hispid, sometimes with scattered papillose hairs above. Inflorescence solitary, terminal, a narrow, spikelike panicle, 6-12 cm. long, less than 5 mm. thick; branches verticillate, erect, short, less than 1 cm. long, overlapping; spikelets short-pedicellate, densely covering the branches to their bases. Spikelets leaden-gray to purplish, terete, 2.9-3.3 mm. long; first glume 1-2 mm. long, lanceolate, faintly 1-nerved; second glume 2.7-3.3 mm. long, 1-nerved, lanceolate; lemma ovate, 2.7-2.9 mm. long, 1-nerved, glabrous; palea equal in length to the lemma but broader, splitting between the nerves when mature; anthers 3, cream-colored to purplish, 1.1-1.4 mm. long. Caryopsis flattened, narrowly elliptical, 1.6-1.8 mm. long; ovary wall gelatinizing when wet. Chromosome number $n = 30$ from Costa Rican material.

Rare, open roadsides, 1,000-1,500 m.; Meseta Central and Cantón

de Dota. September to October. Mexico to Brazil and Bolivia; West Indies.

Sporobolus pyramidatus (Lam.) Hitchc., U.S.D.A. Misc. Publ. 243:84. 1936. *Agrostis pyramidata* Lam., Tabl. Encycl. 1:161. 1791. *Sporobolus argutus* (Nees) Kunth, Rév. Gram. Suppl. XVII. 1829. *Vilfa arguta* Nees, Agrost. Bras. 395. 1829.

Plant perennial, caespitose, spreading; culms 15-60 cm. long, branching only from the base, glabrous, hollow, 1.0-1.5 mm. thick; sheaths longer or shorter than the internodes, glabrous except for the ciliate upper margins; ligule a dense row of stiff white hairs, 0.5-0.8 mm. long; foliage mostly near the bases of the culms; blades flat, whitened, 4-19 cm. long, 2-4 mm. wide, pustulose-hispid on the margins near the base, occasionally with scattered pustulose-based hairs on the upper surface; margins strongly scabrous. Inflorescences solitary, terminal; panicle 3-13 cm. long, pyramidal, ca. 3 × longer than wide; branches whorled, stiffly spreading, glabrous, the lower third to half naked; up to 11 branches in the lowermost whorl; spikelets appressed along the outer portions of the branches. Spikelets grayish or silvery, rather translucent, laterally compressed, 1.6-1.8 mm. long; first glume 0.6-0.7 mm. long, subulate, 1-nerved; second glume 1.6-1.8 mm. long, 1-nerved, lanceolate; lemma 1.5-1.7 mm. long, lanceolate, 1-nerved, glabrous; palea ca. equal to the lemma but broader, splitting when mature between the nerves, the seed discharged between the split halves; anthers 2, tan, 1.2 mm. long; grain 1.1-1.2 mm. long, oval, flattened, the pericarp readily splitting and discharging the brown seed when wet. Chromosome numbers $n = 12, 18$ from Costa Rican specimens.

This species was collected once in Costa Rica from a salina at sea level along the Bay of Nicoya at Colorado. January. Southwestern United States to Argentina; West Indies.

Sporobolus virginicus (L.) Kunth, Rév. Gram. 1:67. 1829. *Agrostis virginica* L., Sp. Pl. 63. 1753. Figure 205.

Vigorous perennial, spreading by extensive stiff, scaly rhizomes; culms 5-50 (85) cm. long, erect, freely branching, 1-2 mm. thick, hollow, glabrous; internodes of lower half of culms short, concealed by the overlapping sheaths of the numerous leaves; sheaths glabrous except for the pilose upper margins; ligule a minute densely ciliate membrane, 0.2-0.4 mm. long; auricular hairs conspicuous, up to 3 mm. long; blades harsh, mostly involute, ridged above and sometimes with scattered papillose hairs on the upper surface, 3-14 cm. long, 2-5 mm. wide. Peduncle included or exserted up to 5 cm.; inflorescence terminal, a densely cylindrical panicle, 2-9 cm. long, 3-10 mm. thick; branches short, erect, densely flowered to their bases; spikelets appressed to the branches, densely overlapping; pedicels from very short to ca. as long as the spikelets. Spikelets grayish or stramineous, glossy, laterally compressed, 2.0-3.3 mm. long; first glume 1-nerved, lanceolate, acuminate, 1.7-2.4 mm. long; second glume 1-nerved, ovate, acuminate, 2.0-3.1 mm. long; lemma ovate, 1.9-2.5 mm. long, 1-nerved; palea equal to the lemma, often splitting between the nerves; anthers tan or purplish, 1.1-1.4 mm. long; caryopsis 0.9-1.2 mm. long; ovary wall gelatinizing but thin.

Occasional on coral or sandy beaches, Isla Uvita, Moín. June to September, possibly yearlong. Southeastern United States to Peru and Brazil; West Indies; tropics of the Old World.



FIG. 205. *Sporobolus virginicus*. Blooming culms with rhizomatous bases.

Length and width of the leaf blades vary greatly. The Costa Rican specimens have larger blades than most. Seed set is apparently low.

STENOTAPHRUM Trinius

REFERENCE: J. D. Sauer, Revision of *Stenotaphrum* (Gramineae: Paniceae) with attention to its historical geography, *Brittonia* 24:202-222. 1972.

Stoloniferous grasses; leaf sheaths flattened and keeled; leaves often subopposite by suppression of internodes; inflorescence a terminal or axillary flattened corky spike, bearing spikelet groups alternately in 2 rows along one side of the rachis, usually sunken into hollows of the rachis, which falls intact from the plant or tardily disarticulates into individual segments; spikelets solitary, paired, or in 3's, subsessile or one sessile and one on a thick angular pedicel which is continued beyond the spikelet as a stiff angular beak or bears a third spikelet. Spikelets disarticulating from the rachis or remaining on it, lanceolate or ovate, acute, awnless, placed with the first glume away from the rachis; first glume a short usually nerveless scale; second glume membranaceous, strongly gibbous, as long as the lemma of the lower floret, ovate, acute, 5-7-nerved; lower lemma firm, flat on the back and with inflexed margins, 3-5-nerved, acute; palea stiff, with inflexed edges, ca. as long as the lemma; floret sterile, staminate, or perfect; upper floret with a stiff, acute, gibbous, faintly 5-nerved lemma, its thin margins overlapping the edges of the palea but not inrolled; palea indurate; flower perfect.

Stenotaphrum is a small genus of grasses of the tropics of the Old World. (Panicoideae: Paniceae.)

Stenotaphrum secundatum (Walt.) O. Kuntze, Rev. Gen. Pl. 2:794. 1891. (Given as *S. secundum*, sphalm. for *secundatum*). *Ischaemum secundatum* Walt., Fl. Carol. 1788. Figure 206.

Duration indefinite, the plants creeping extensively by stiff stolons; culms flattened, glabrous, solid, pithy; branching abundant; prophylla prominent, lanceolate, 10-25 mm. long; nodes of stolons prominent, usually with 2 subopposite leaves and 2 erect branches at each node; erect flowering culms usually 10-25 cm. tall, leafy; sheaths strongly flattened and keeled, much shorter than the internodes, glabrous except for short cilia at the throat; ligule a very short membrane, strongly ciliate, ca. 0.5 mm. long; blades flat, glabrous, 5-20 cm. long, 5-11 mm. wide, the midrib keeled near the base; apex of blades blunt, rounded or emarginate. Inflorescences terminal and from upper leaf axils, the rachis thick, flattened, falcate, 3-4 mm. wide, 5-10 cm. long. Spikelets 3.5-5.2 mm. long; first glume blunt and rounded, or a truncate collar, nerveless or rarely 3-nerved, 0.5-1.6 mm. long; second glume and lower lemma equal and as long as the spikelet; lower floret sterile, staminate, or perfect-flowered; second floret perfect-flowered; some clones entirely sterile; anthers 3, tan or purple, 2.0-2.5 mm. long. Chromosome number $n = 9$ from Costa Rican material.

Inner margins of sea beaches, Pacific Coast; occasional in the interior at low elevations, probably in cultivation. Blooming June to December, probably yearlong. Worldwide in warm climates; sometimes cultivated as a coarse lawn grass. A striped-leaf form is sometimes cultivated for ornament.



FIG. 206. *Stenotaphrum secundatum*. Blooming plant with stoloniferous base, two views of a spikelet, fertile floret.

Other chromosome counts are given by Sauer (1972).

STIPA Linnaeus

Perennial grasses; inflorescence a terminal panicle; spikelets 1-flowered, disarticulating above the glumes; glumes equal, longer than the floret, several-nerved; lemma hard, cylindrical, convolute, the margins overlapping and concealing the palea; callus hard, sharp, bearded; awn stiff, geniculate, attached at the tip of the lemma, the basal segment usually strongly flattened and tightly twisted.

A large genus of about 250 species, in temperate regions of the entire world; mostly alpine in the tropics. The genus is readily recognized by the hard, cylindrical floret with a strong awn and exceedingly sharp callus. The floret functions as a ratchet-drill device to cause self-planting of the seed. The awns are hygroscopic and wind tighter when dried and unwind when moistened. The genus is closely related to *Oryzopsis*, with which it forms spontaneous hybrids. The limits of these two genera and the related genera *Piptochaetium* and *Nassella* are obscure, and many species have been transferred from one to another by authors. (Pooideae: Stipeae.)

KEY TO SPECIES OF *Stipa*

- 1a. Lemma with crown of long hairs, 2-5 mm. long, at apex; awn firmly attached to lemma 2
- 1b. Lemma lacking crown of long hairs at apex; awn readily detachable from mature lemma See: *Nassella linearifolia*
- 2a. Plants 20-35 cm. tall; panicle stiff, narrow, 3-10 cm. long; palea as long as lemma *S. hans-meyeri*
- 2b. Plants 50-115 cm. tall; panicle lax, 15-35 cm. long; palea less than half as long as lemma *S. ichu*

Stipa ichu (Ruiz & Pav.) Kunth, Rév. Gram. 1:60. 1829. *Jarava ichu* Ruiz & Pav., Fl. Peruv. Chil. 1:5, pl. 6. 1798. Figure 207.

Perennial, in dense, hard tufts; culms erect, 50-115 cm. tall, unbranched, ca. 2 mm. thick, hollow, thick-walled, minutely scabrid; nodes glabrous, not prominent; most leaf blades in an erect basal tuft, stiff; culm leaf sheaths ca. half the length of the internode, glabrous except for ciliation on the margins and a few auricular hairs at the apex; firm sheath auricles present; ligules 0.5 mm. long, membranaceous; blades 25-70 cm. long, 1.5-2 mm. wide, involute, strongly ridged above, scabrid beneath; peduncle minutely puberulent or scabrid, included or exerted up to 10 cm. Panicle solitary, terminal, narrowly cylindrical, 15-35 cm. long, 2-3 cm. wide, lax, nodding, silvery and plummy at maturity; branches and pedicels scabrous. Spikelets very numerous, compactly arranged; glumes silvery, thin, membranaceous, often purplish near the base, equal, narrowly linear-lanceolate, tapering to an acuminate apex, 7.5-11 mm. long, faintly 3-nerved; floret cylindrical, narrowly fusiform, 2.5-3.5 mm. long, including the rather blunt callus; lemma tan, rather uniformly appressed-pubescent, the edges meeting; palea oblong, 0.7-1.2 mm. long, 2-nerved, sometimes pubescent, awn twice-geniculate, 10-20 mm. long, the lower segment twisted; anthers 3, 1-1.2 mm. long; lemma tapering



FIG. 207. *Stipa* and *Nassella* species. *S. ichu*: A, glumes and floret; *S. hans-meyeri*: B, glumes and floret; *Nassella linearifolia*: C, glumes and floret.

at apex to a short neck, bearing a prominent tuft of straight spreading white hairs, 3-4.5 mm. long. Chromosome number $2n = 40$ from Costa Rican material.

Occasional on open slopes; Irazú, 2,600-3,000 m.; inflorescences have been seen from June to November. Mexico to Argentina. Chromosome numbers of $2n = 40$, 42, and 44 have been reported for this species.

Stipa hans-meyeri Pilger, Bot. Jahrb. 56, Beibl. 123:24. 1920. Figure 207.

Densely tufted perennial, the foliage stiffly erect, rigid; plants 20-35 cm. tall; culms ca. 0.5 mm. thick, glabrous, shining, hollow, thick-walled; nodes glabrous; leaves 3-4 per culm; sheaths mostly overlapping; ligules 3-4 mm. long, firm, erect, pointed, firmly membranaceous; blades ca. 1 mm. wide, completely involute, glabrous below, the upper surface ridged and scabrous, tip acerose. Peduncle minutely puberulent; panicle strict, few-flowered, 3-10 cm. long, often with a membranaceous prophyll at the base. Spikelets erect, terete, glumes equal, 7-9.5 mm. long, narrowly lanceolate, purplish at the base, 1- or faintly 3-nerved; lemma 3.5 mm. long, including the rather short callus, narrowly elliptical, the nerves obscure; margins barely meeting, callus short-bearded; body with a line of pubescence along the margins and another along the midrib; apex with a conspicuous tuft of spreading white hairs 2.4-4 mm. long; palea 3 mm. long, oblong, 2-nerved, terminating in a short beak. Chromosome number $n = 11$ from a Costa Rican specimen.

This South American species is known from Central America only by two collections from the páramos of Chirripó Grande and Cerro Buena Vista, at altitudes above 3,400 m. Blooming dates November to April. These high-altitude regions are known to support other South American species, which are probably migrants from South America during the Pleistocene cooling of the tropics.

STREPTOCHAETA Schrader ex Nees

REFERENCES: V. M. Page, Leaf anatomy of *Streptochaeta* and the relation of this genus to the bamboos, Bull. Torrey Bot. Club. 74:232-239. 1947; and Morphology of the spikelet of *Streptochaeta*, Bull. Torrey Bot. Club 78:22-37. 1951.

Erect perennial herbs from knotty crowns; culms mostly unbranched, sometimes decumbent and rooting at the lower nodes, producing new plants from the rooted portions; leaf blades ovate, borne on short pseudopetioles. Inflorescence a terminal spike of pseudospikelets, these spirally arranged on the slender angular rachis and deciduous from it as a group, entangled by the twisted and contorted awns. Pseudospikelets terete, bearing ca. 11 spirally imbricated stiff bracts, the lowermost 4 or 5 much shorter than the rest; longest (nominally sixth) bract tapering into an elongated, coiled and twisted awn; facing this bract are two stiff acute lanceolate bracts, and within this group of bracts a perfect flower with 3 stiff, elongated, erect, many-nerved lodicules; stamens 6, united at the base of the filaments; styles 3.

The above structure is usually interpreted as a spikelet; however, studies by Page (1951) strongly indicate that the "spikelet" is instead a

compound structure equivalent to the pseudospikelets of certain bamboos, to which group *Streptochaeta* is related. The number and characters of the short basal bracts in our material are more variable than those indicated by Page. (Bambusoideae: Streptochaeteae.)

Species three, from Mexico to South America. The genus is often regarded as the most primitive of grasses, but bears many evidences of complexity in vegetative and flowering structure.

KEY TO SPECIES OF *Streptochaeta*

- 1a. Spike dense, many-flowered; rachis triquetrous, densely and coarsely papillose-hirsute on angles; internodes between successive pseudospikelets 1-4 mm. long
S. sodiroana
- 1b. Spike slender, few-flowered; rachis flattened, puberulent; internodes between successive pseudospikelets 10-25 mm. long *S. spicata*

***Streptochaeta sodiroana* Hack., Oesterr. Bot. Z. 40:113. 1890.**
Figure 208.

Perennial; culms in small clumps, sometimes decumbent and rooting at lower nodes, usually unbranched, 2-3 mm. thick, pithy, with a small cavity, glabrous; lower internodes longer than the sheaths; upper internodes covered by sheaths; leaf sheaths glabrous except just above the appressed-hispid nodes, papillose-ciliate along the upper margin and the edges of the pseudopetioles; ligule none; pseudopetioles flattened, terminating at the base of the blade in a short, appressed-hispid pulvinus; blades elliptic-ovate, somewhat asymmetric, abruptly acuminate at the apex, glabrous and smooth-margined, conspicuously tessellate. Peduncle included or long-exserted, sparsely puberulent near the base, becoming coarsely hirsute above, papillose-pubescent on the angles of the rachis and the cupules of the spikelets; spike 15-27 cm. long, densely cylindrical, ca. 1 cm. thick; pseudospikelets spirally arranged around the rachis, becoming bound together by the intricately coiled and twisted awns and eventually shed as a group. Pseudospikelets terete, 13-17 mm. long, excluding the awn; awned bract tapering into a minutely hispid awn, the lower segment straight, 3-8 cm. long, the terminal segment 3-4 cm. long overall, but much contorted, golden brown; the two bracts facing the awned bract stiff, barely united at the base; lodicules 3, narrowly triangular, stiff, erect, ca. 11 mm. long; anthers 6, 4-5 mm. long. Chromosome number $n = 11$.

Occasional in undisturbed moist lowland forest, from sea level to 300 m. elevation; most common in the provinces of Puntarenas, from Quepos to Golfito and near Rincón de Osa, near the coast; and Limón, near Limón and Guapiles. One collection was secured from near Puerto Viejo in the Province of Heredia, and another near Florencia in Alajuela. Belize; Honduras; Costa Rica; Panama; Ecuador. Blooming has been noted from October to ca. February 1, but old inflorescences may be found on the plants at almost all seasons. Since the pseudospikelets become completely entangled by their awns, they are often not shed from the plant. The rachis or peduncle when old may bend down, carrying the pseudospikelets to the soil, where they may germi-

nate in a mass. Seedlings have been seen twice, in July and September. In addition, the rooting of old culms from their lower nodes seems to be an effective means of reproduction.

***Streptochaeta spicata* Schrad. ex Nees, Agrost. Bras. 537. 1829. Figure 208.**

Perennial from a knotty crown; culms erect or sometimes decumbent at the base and rooting from lower nodes, producing new plants; culms 25-90 cm. tall, rarely branching, hollow, glabrous except for a puberulent line down one side; nodes mostly concealed by the overlapping sheaths, appressed-pubescent; sheaths 2-4 cm. long, puberulent, mostly overlapping; auricles truncate or erect, prominent, coarsely papillose-ciliate; ligule none; blades slightly asymmetric, ovate, tapering to an acute apex, 8-15 cm. long, 2.5-4.5 cm. wide, mostly glabrous but ciliolate near the tip, borne on a short, flattened pseudopetiole which terminates in an appressed-hispid pulvinus at the base of the blade. Inflorescence solitary, terminal; peduncle mostly included in the bladeless upper sheath; rachis 6-12 cm. long, flattened, puberulent; internodes 10-25 mm. long. Pseudospikelets few (3-9), erect, appressed to the rachis, terete, disarticulating from the rachis but becoming entangled by the much-contorted awns and usually remaining attached to the woolly tip of the rachis; pseudospikelet with about 5 short, blunt, many-nerved outer bracts ca. 2-3 mm. long; sixth (awned) bract ca. 2 cm. long, tapering into a stiff slender awn, its basal straight segment 2-3 cm. long, the upper twisted and contorted segment glabrous. Chromosome number $n = 11$.

Moist forests; rare in Costa Rica and known only from the following two collections. Guanacaste: Volcán Rincón de la Vieja, west side; montane forest, 900 m., Hacienda Guachipelin, *Pohl & Davidse 11672*, 17 January 1969; Parque Nacional de Santa Rosa; moist forest in a ravine, elevation 300 m., *Pohl & Erickson 12631*, 23 July 1971. Southern Mexico, Honduras, Nicaragua, Costa Rica, Panama; northern South America from Trinidad to Ecuador and Paraguay.

STREPTOGYNA Beauvois

Perennial herbaceous grasses; leaf blades narrowed to a pseudopetiole; an external membranaceous ciliate ligule present along the collar; inflorescence a slender unilateral raceme of narrow erect spikelets; rachis triquetrous, grooved on two sides, the pedicels of the spikelets alternately fitting into the grooves; third side of rachis convex. Glumes unequal, much shorter than the florets; florets several; lemmas convolute, concealing the palea, firm, awned; callus prominent, oblique; lodicules 3, plane, narrowly spatulate, vasculated; stamens 2 or 3; ovary with style terminating in 3 greatly elongated stiff, twisted stigmatic branches, which at maturity become entangled with those of other spikelets, causing them to fall as a group. The leaf anatomy, lodicules, and the basic chromosome number of $x = 12$ are all bambusoid.

Species two, one in the tropics of the Old World. (Bambusoideae: Streptogyneae.)

***Streptogyna americana* Hubbard, Hook. Icon. Plant., Ser. 5, Vol. 6: Tab. 3572:5. 1956. Figure 209.**

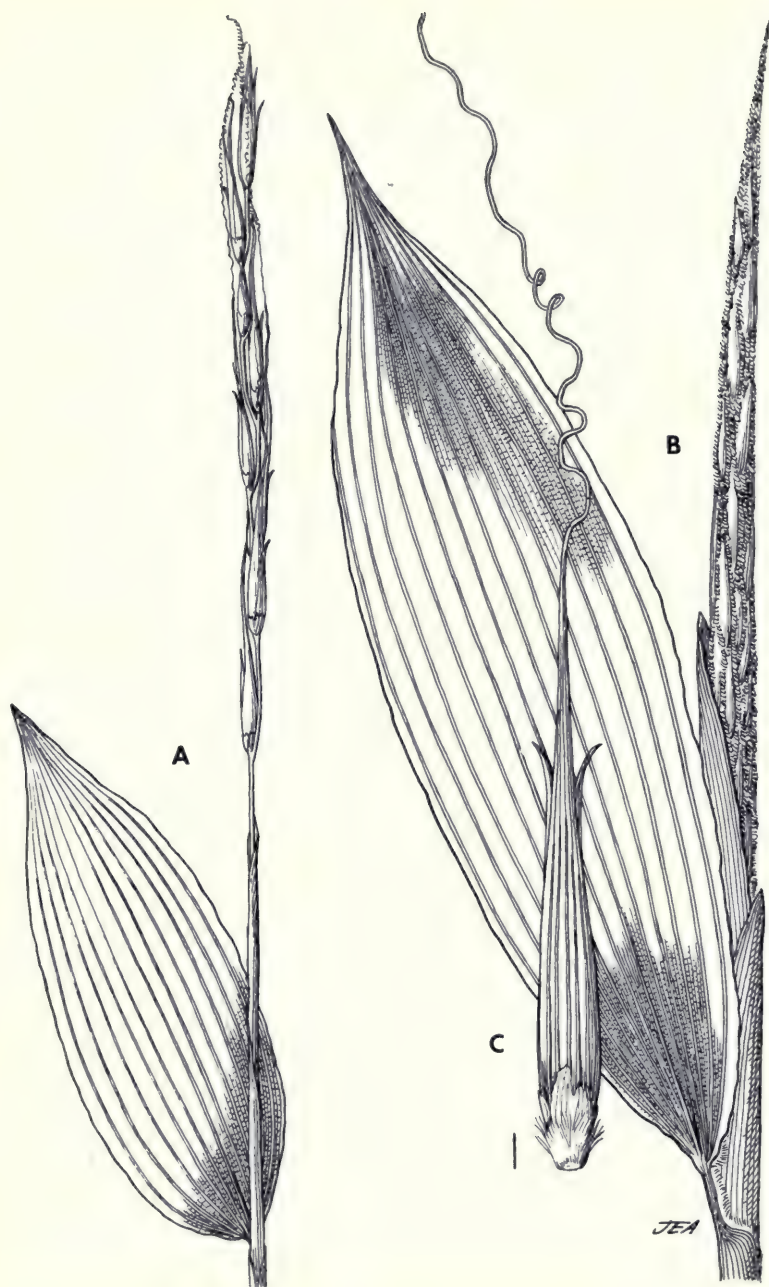


FIG. 208. *Streptochaeta* species. *S. spicata*: A, leaf and inflorescence; *S. sodiroana*: B, leaf and inflorescence; C, pseudospikelet.

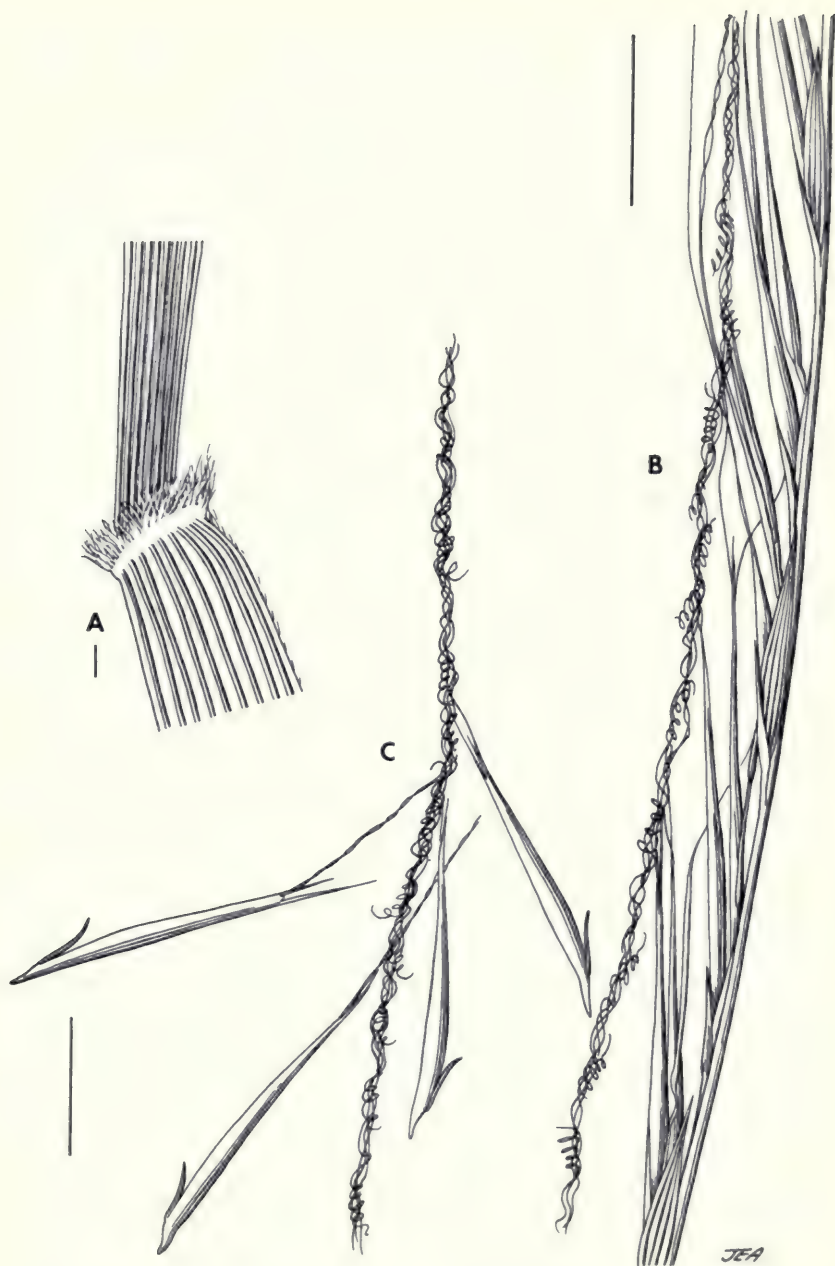


FIG. 209. *Streptogyna americana*. A, leaf base and external ligule; B, inflorescence; C, group of florets entangled by the persistent stigmas.

Culms erect to arching, 50-150 cm. tall, unbranched, from short, knotty rhizomes; leaves many, aggregated near the base, with overlapping sheaths; culms solid, pithy, glabrous; nodes glabrous, not prominent; sheaths mostly overlapping, glabrous except somewhat retrorsely hispid near the apex; ligule a short membrane, ciliate with a dense fringe of stiff hairs, ca. 2 mm. long; a similar external ligule surrounds the collar at the same level; leaf blades numerous, the larger ones 55-65 cm. long, 10-15 mm. wide, mostly glabrous. Peduncle solid, glabrous except puberulent near the apex; inflorescence a solitary terminal raceme, slender, 30-47 cm. long; lowermost spikelets sometimes abortive. Spikelets on short erect pedicels, solitary, 3-5 cm. long, excluding the awns and style branches; disarticulation above the glumes and between the florets; glumes stiff, the first 3-5-nerved, lance-linear, 6-8 mm. long; the second 7-9-nerved, ovate, awn-tipped, 12-15 mm. long; florets 3-5, the apical one rudimentary; lemmas firm, convolute, 15-25 mm. long, with a hard oblique callus 1-3 mm. long; rachilla internodes sigmoid, slender, acuminate, 4-5 mm. long; lemma obscurely 7-9-nerved, glabrous, minutely tuberculate, 15-25 mm. long, with an awn 20-25 mm. long; palea hidden within the lemma, the awned tip emerging above the apex of the lemma; caryopsis linear-cylindric, grooved on one side, ca. 12 mm. long.

Rare; lowland forest, Los Tejares, in the valley of the Río Ceibo; elevation ca. 200 m.; Finca los Helechales, 1,800 m. December to April. Chiapas and Vera Cruz, Mexico, Belize, northeastern Nicaragua, southern Costa Rica, Panama, Venezuela, Trinidad and Surinam to Brazil.

This species was known as *S. crinita* Beauv. in earlier American publications, but this name refers to a similar Old World species.

SWALLENCHLOA McClure

REFERENCE: F. A. McClure, Genera of bamboos native to the New World (Gramineae: Bambusoideae), Smithsonian Contr. Bot. 9:106-113. 1973.

Plants densely caespitose; rhizomes pachymorph; culms not bearing thorns; internodes cylindrical or flattened on the branch-bearing side, usually with a small central cavity formed by the breakdown of the central parenchyma; midculm branch complement usually of 3-5 primary branches, which may become rebranched; branches intravaginal, closely ascending; main culm sheaths with short, erect triangular blades; ligule a short, stiff membrane; foliage blades on branches usually stiff, often tessellate. Inflorescence a dense cylindrical terminal panicle. Spikelets disarticulating above the reduced glumes; lower 2 florets sterile; terminal floret perfect; rachilla not prolonged beyond the palea; lodicules 3, flat, vasculated, one smaller than the other pair; anthers 3; stigmas 2. (Bambusoideae: Chusqueae.) Chromosome number $n = 20$.

Swallemchloa is closely related to *Chusquea*, differing mostly in the slightly hollow internodes, in the intravaginal rather than extravaginal branching, equal rather than unequal primary branching, and the dense inflorescences. Most of the species are high-alpine, often above timberline. The Costa Rican species share a basic chromosome number of $n = 20$ with *Chusquea* species. Since this is an unusual number

among the Bambusoideae, it suggests that these two genera are very closely related.

KEY TO SPECIES OF *Swallenochloa*

- 1a. Ligules 1-7 cm. long, acuminate; leaf blades lax, not strongly tessellate; panicles 25-50 cm. long *S. longiligulata*
- 1b. Ligules up to 5 mm. long, truncate; leaf blades strongly tessellate; panicles less than 20 cm. long 2
- 2a. Leaf blades 1.5-11 cm. long, 4.5-12 mm. wide, yellowish green; ligules 0.5-1.0 mm. long; culms 1-3 m. tall; anthers 2.7-3.5 mm. long *S. subtessellata*
- 2b. Leaf blades 6-19 cm. long, 11-23 mm. wide, dark green; ligules 3-5 mm. long; culms up to 10 m. long; anthers 3.6-4.5 mm. long *S. vulcanalis*

Swallenochloa longiligulata Sods. & Cald., Brittonia 30:305. 1978.

Figure 210.

Long-lived perennial bamboo; caespitose in dense clumps of up to 50 culms; culms arching, 3-10 m. long, up to 3 cm. thick, branching from the middle and upper nodes, cylindrical, soft, with an irregular central cavity, glabrous or with patches of appressed-hispid hairs; nodes with a sheath girdle and nodal ridge, glabrous; culms sheaths 17 cm. long (2 seen), appressed-hispid especially toward the apex; ligule thick, stiff, hispid-ciliate, up to 2 mm. long; culm blades deltoid, 5.5 cm. long, 1 cm. wide, erect, as wide as the sheath apex, appressed-hispid above; foliage-bearing branches 5-10 per node, 70-90 cm. long, some of them rebranching; leaf sheaths on primary branches overlapping, keeled, glabrous or ciliate on the margins, the lower ones often deciduous, the middle ones with deciduous blades; sheath auricles united with the ligule, erect, stiff, vasculated, the whole 1.5-7.0 cm. long, acuminate; external ligule stiff, ca. 0.5 mm. long; leaf blades flat, ovate 9-22:1, acuminate, 12-28 cm. long, 8-23 mm. wide, dark green, glabrous, not conspicuously tessellate, the midrib prominent beneath; margins white-banded, scaberulous. Inflorescences numerous, terminal on leafy branches, the peduncle mostly included in the uppermost sheath; rachis, branches, and pedicels scabrous or appressed-pubescent; panicles very slender, 25-50 cm. long, ca. 1 cm. thick, loose, the rachis visible; lower branches up to 11 cm. long, the upper ones much shorter, all strictly ascending; pedicels erect, angular, mostly longer than the spikelets. Spikelets nearly terete, falcate, stramineous or purplish, 6.0-7.7 mm. long, tapering to a point, disarticulating above the glumes only; first glume 0.3-0.7 mm. long, blunt; second glume similar, 0.9-1.2 mm. long, both nerveless; first sterile lemma 3.0 mm. long, 3-nerved, acuminate; second sterile lemma 3.7-4.8 mm. long, 3-5-nerved, ovate, acuminate; fertile lemma 5.7-6.4 mm. long, rounded on the back, 5-7-nerved, the margins enfolding the palea; palea ca. as long as the lemma, broad, enwrapping the flower, 2-keeled, grooved between the keels, the nerves projecting as rigid points; lodicules flat, vasculated, ciliate toward the blunt apex; anthers 3, yellow, 3.5-4.1 mm. long; caryopsis fusiform, 3.8-5.0 mm. long, brown; raphe dark, two-thirds as long as the grain, terminating in a depressed chalaza; embryo small, basal. Chromosome number $n = 20$ from the type.

Cordillera de Talamanca, from 1,400 to 3,000 m. elevation; Volcán Barba. The only recent bloom of this species occurred in 1972 and 1973. The colony at Tres de Junio contained only a few blooming plants, but the stand at Alto de Roble was almost entirely in bloom and dying in 1973. Recent examination of the area appears to indicate that the



FIG. 210. *Swallenochloa longiligulata*. A, seedlings; B, branch with persistent leaf sheaths; C, culm with branch complement; D, inflorescence; E, group of spikelets.

colony has now disappeared. This stand produced some well-filled caryopses, and I collected a number of seedlings growing on moss among the old dying plants. The seedlings have narrow, pubescent leaves and lack the very elongated auricle-ligules of the adult form. Most of the spikelets on the blooming plants appear to be sterile, and very few caryopses were seen. The following specimens were collected in flower. Prov. Heredia, Alto de Roble, Río Las Vueltas: *Lent 2626*, *Burger & Gentry 9039*, *Pohl & Selva 12810*; Prov. Alajuela, Alto Paloma, 12 km. N of La Luisa, 1,950 m., *Pohl & Davidse 11708*. Prov. San José, Tres de Junio, along CIA 5 km. SE of El Empalme, 2,000 m., *Pohl & Selva 12842*, (Type).

***Swallenochloa subtessellata* (Hitcch.) McClure**, Smithsonian Contr. Bot. 9:113. 1973. *Chusquea subtessellata* Hitcch., Proc. Biol. Soc. Wash. 40:81. 1927. Figure 211.

Caespitose in dense clumps; culms mostly 1.5-3 m. tall, erect, stiff; rhizomes short, pachymorph; culms branching abundantly from the middle and upper nodes, the branches strict and erect; internodes of culms 4-8 mm. thick, with a small irregular pith cavity; surfaces glabrous, often with crustose wax deposits; nodes enlarged, with a sheath girdle and a nodal ridge, the branch complement arising between them; main culm sheaths deciduous, 12-13 cm. long (2 individuals), rounded to the apex; sheath blades narrower than the sheath apex, 2.0-2.5 cm. long, 7-8 mm. wide, narrowly triangular, acuminate; ligule 1.7 mm. long, thick, decurrent onto the sheath margin, minutely ciliate; back of sheath glabrous except for the ciliate margin; primary foliage-bearing branches several per node, stiff and erect, rebranching; leaf sheaths keeled, overlapping, persistent after the blades disarticulate but becoming loose, pectinate-ciliate on the margins and collar, glabrous or appressed-pilose on the surfaces; ligule a thick, ciliate membrane, 0.5-1.0 mm. long; leaf blades yellowish green, stiff and leathery, ovate, 1.5-11 cm. long, 4.5-12 mm. wide, the base rounded to a short pseudopetiole ca. 2 mm. long; apex abruptly acuminate into a rigid involute point; blades glabrous except for the white-banded, strongly scabrous margins. Panicles terminal on the leafy branchlets; peduncles mostly included in the terminal sheaths, puberulent; panicles densely cylindrical, purple, 5-13 cm. long, 7-14 mm. thick; branches numerous, clustered, short, erect; spikelets mostly on pedicels as long as themselves, overlapping and concealing the rachis and branches. Spikelets 5.5-7.0 mm. long, purple; disarticulation above the glumes only; glumes blunt, oval or circular, nerveless, the first 0.4-0.8 (1.2) mm. long, the second 0.6-1.8 mm. long; first sterile lemma 5.0-6.5 mm. long, rounded on the back, acute or awn-tipped, 5-7-nerved, glabrous or the upper margins short-ciliate; second sterile lemma similar, 5.0-7.0 mm. long; fertile floret 5.0-6.5 mm. long, the lemma glabrous, 5-7-nerved, acute or awn-tipped; palea slightly shorter, 2-4-nerved, broad, enveloping the flower; lodicules 3, flat, vasculated; anthers 3, yellow, 2.7-3.5 mm. long; styles 2, naked below; caryopses not seen. Chromosome number $n = 20$ from Costa Rican specimens.

Common on páramos along the CIA at elevations above 3,000 m. Asunción, Buena Vista, Las Vueltas, Cuerici, Chirripó, Irazú, Poás. Inflorescences may be found on the plants at all seasons of the year. Costa Rica; Volcán Chiriqui.



FIG. 211. *Swallenochloa subtessellata*. A, base of plant with buds; B, culm sheath; C, leafy branch; D, several inflorescences; E, spikelet.

This species has been observed bearing inflorescences over a long period of years. The amount of bloom varies greatly from year to year, but it is always possible to find some plants with panicles. Flowering does not seem to result in death of the old clones, as is common in the related genus *Chusquea*. Despite the abundance of flowering, I have not detected caryopses in herbarium specimens, and have never observed seedlings in the field.

***Swallenochloa vulcanalis* Sods. & Cald., Brittonia 30:309. 1978. Figure 212.**

Caespitose bamboo in dense small clumps; culms erect when short, arching when tall, up to 10 m. long, stiff; internodes cylindrical, up to 2.5 cm. thick, solid or with an irregular lumen in the center; nodes glabrous; sheath girdle evident; culm sheaths glabrous, ca. 15 cm. long, rounded to a very reduced blade; ligule in the form of an inverted V, a thick ciliate membrane, ca. 1 mm. long (1 individual seen); primary branch bud flanked with few buds of foliage-bearing branchlets, these up to ca. 10 per node, stiff, usually with 3-4 leaf blades in addition to the deciduous lower leaves; fascicle of branchlets dense; subtended by basal bracts and prophylls; leaf sheaths glabrous except for the ciliate overlapping margin; ligule a stiff membrane, 3-5 mm. long, decurrent on the sheath margins; leaf blades flat, rather stiff and leathery, olivaceous, ovate 6-9:1, 6-19 cm. long, 11-23 mm. wide, conspicuously tessellate; surfaces glabrous; margins with white, scabrous, cartilaginous bands; base abruptly rounded to a pseudopetiole 1-3 mm. long; apex caudate-acuminate. Inflorescence a dense cylindrical purple panicle, 9-19 cm. long, 1-2 cm. thick; peduncle included in the uppermost blade-bearing sheath; rachis, branches, and pedicels puberulent or scabrous; pedicels appressed, the lateral ones 2-3 mm. long. Spikelets purple, 6.2-10 mm. long; glumes broadly rounded, nerveless or the second 1-nerved, the first 0.6-1.0 mm. long, the second 1.2-1.5 mm. long; disarticulation above the glumes, the remainder of the spikelet falling as a unit; sterile lemmas 2, rounded on the back, ciliate near the keeled tip; first sterile lemma 3.7-6.3 mm. long, ovate 2.3-3.5:1, the awn ca. 0.5 mm. long; nerves 4-5, the lateral ones closely paired; second sterile lemma similar, 5.0-7.4 mm. long, ovate 3.2-3.7:1, the awn tip to 1 mm. long; nerves 5, equally spaced; surfaces of sterile and fertile lemmas scabrid or finely puberulent; fertile lemma 5.7-7.5 mm. long, ovate 2.1-2.5:1, 5-nerved, with a short awn-tip, rounded on the back, keeled toward the ciliate tip; palea 5.7-6.8 mm. long, slightly shorter than the lemma, 4-nerved, bidentate at the tip; lodicules 3, obovate, flat, vasculated only near the middle, ciliate with stiff elongate hairs on the upper third; anthers 3, yellow, 3.6-4.5 mm. long; style short; stigmas 2; caryopsis not seen. Chromosome number $n = 20$ from a specimen from Turrialba (reported as *C. lehmannii*).

This species is common near the crater of Irazú and occurs at upper elevations of Poás and Turrialba as well. It was first collected in flowering condition at the crater of Irazú in 1900. We obtained a second blooming collection on Volcán Turrialba in 1968. Since the Irazú Crater is a much-visited site and this species still occurs there, it is likely that blooming is rare. Elevations 2,300-3,300 m.

This species is recognizable in vegetative condition by the leathery, strongly tessellate leaf blades. In appearance, it is intermediate be-

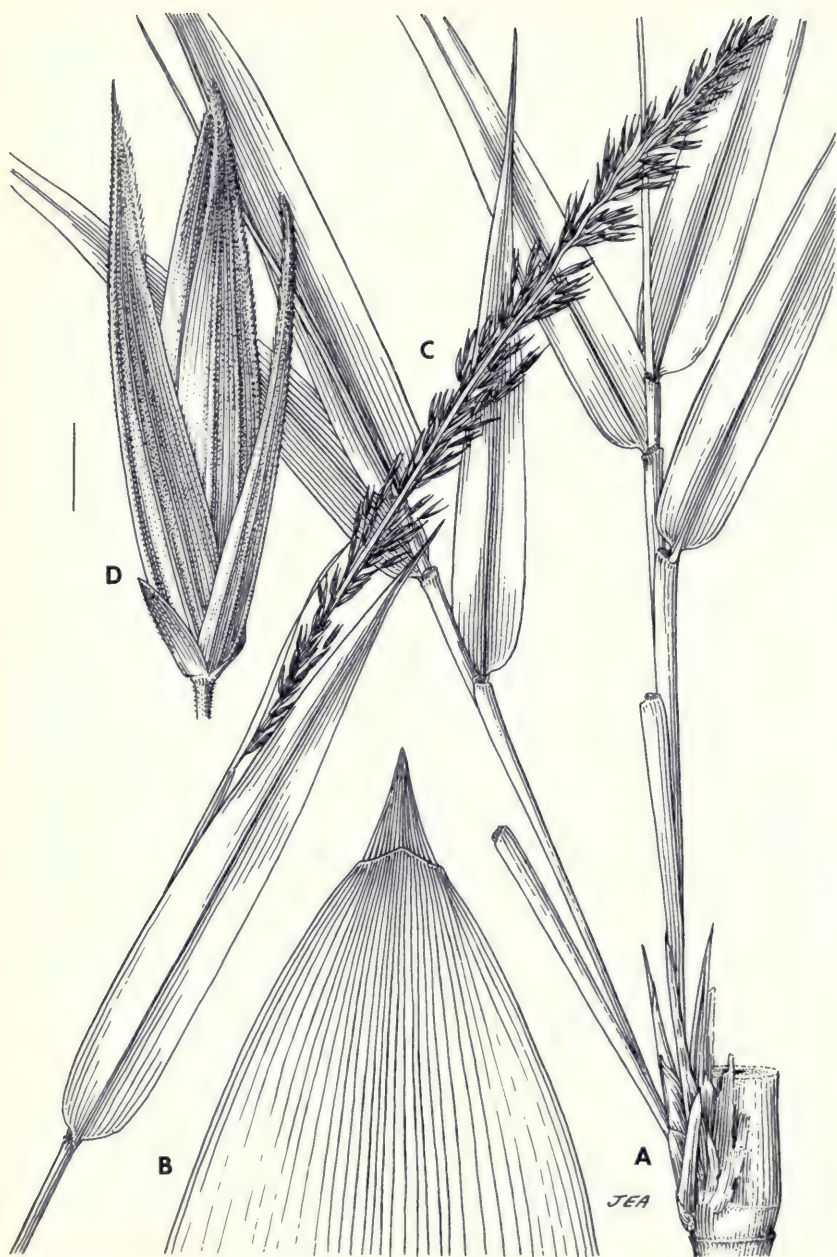


FIG. 212. *Swallenochloa vulcanalis*. A, branch complement; B, culm sheath; C, inflorescence; D, spikelet.

tween *Swallenochloa subtessellata* and the common species of *Chusquea*.

THRASYA Humboldt, Bonpland, & Kunth

Perennial grasses; peduncles several from the uppermost sheath, elongated, bearing at their summit a single, slender, usually arched raceme; rachis flattened, its membranaceous margins partly enveloping the spikelets. Spikelets borne in a single row along the midrib of the rachis, minutely pedicellate, in pairs, the members of each pair placed longitudinally, with the first glumes and lower (sterile) lemmas facing each other and the second glumes and fertile lemmas facing apart; disarticulation below the glumes; spikelets more or less dorsally compressed; first glume short or obsolete; second glume shorter or longer than the spikelet; sterile lemma ca. as long as the spikelet, stiff, deeply grooved in the middle and often splitting longitudinally when mature, sometimes with a staminate flower; palea well developed, also grooved; upper (fertile) floret coriaceous, the lemma dorsally flattened, sometimes bearded at the apex, its margins inrolled over the edges of a stiff, flat palea of equal length.

Thrasya is a genus of ca. 20 species, ranging from Mexico to tropical South America and the West Indies. The species could be confused with some of the species of *Paspalum* that have single racemes. They differ in the placement of the spikelets in a single row, back to back in pairs, whereas *Paspalum* species have spikelets all placed with the backs of the fertile lemmas turned toward the midrib. (Panicoideae: Paniceae.)

KEY TO SPECIES OF *Thrasya*

- 1a. Racemes 2-6 cm. long 2
- 1b. Racemes 10-30 cm. long 3
- 2a. Spikelets glabrous or rarely with a few minute marginal hairs; margins of rachis not ciliate *T. campylostachya*
- 2b. Spikelets conspicuously bearded; margins of rachis conspicuously ciliate with stiff, yellow, papillose-based hairs *T. trinitensis*
- 3a. Rachis ca. 2.5 mm. wide; spikelets 3.3-4.5 mm. long *T. robusta*
- 3b. Rachis 4-5 mm. wide; spikelets 4.5-5.5 mm. long *T. petrosa*

***Thrasya campylostachya* (Hack.) Chase, Proc. Biol. Soc. Wash. 24:115. 1911. *Panicum campylostachyum* Hack., Oesterr. Bot. Z. 51:367. 1901. Figure 213.**

Caespitose perennial; culms 50-110 cm. long, decumbent, branching from lower and middle nodes, the internodes 1.0-1.5 mm. thick, hollow, glabrous or pilose just below the apex; nodes bearded; sheaths pilose; ligule a brown membrane, 0.7-1.5 mm. long; blades keeled, flat, 6-17 cm. long, 3-7 mm. wide, pilose on both surfaces. Peduncles up to 5 from the terminal sheath, exserted 10-15 cm.; inflorescence a solitary terminal raceme on each peduncle, arcuate, 4-6 cm. long, the rachis slender, flattened, 1.5-2.0 mm. wide, bearing a spikelet at its tip. Spikelets 2.2-2.8 mm. long, ovate or obovate 2:1, glabrous or with a few hairs near the margins of the bracts; basal callus small, ca. 0.2 mm. long; first glume broad, blunt, 0.4-1.2 mm. long; second glume 1.5-2.2 mm. long, ovate, 5-nerved, shorter

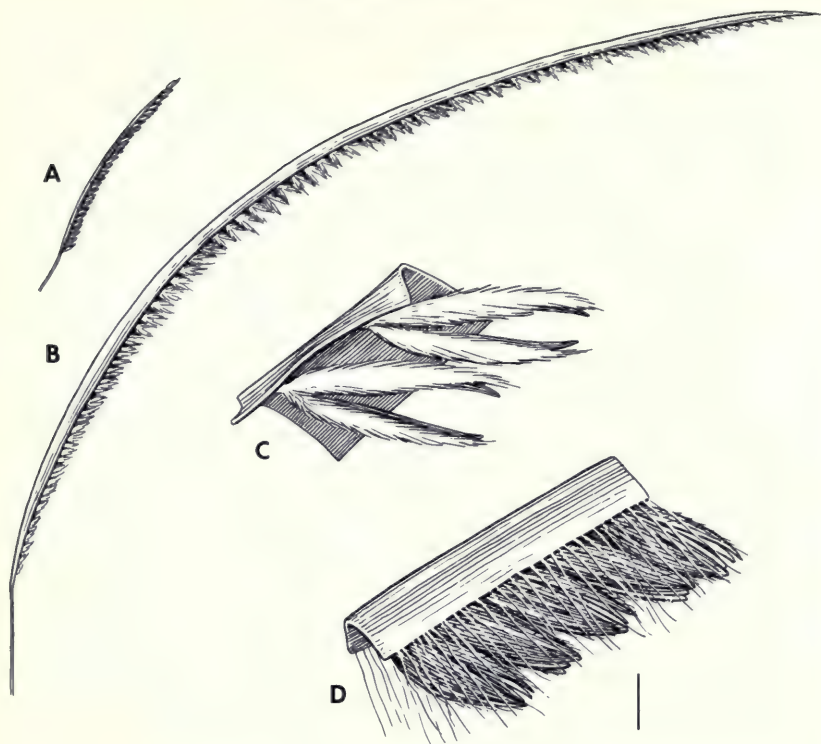


FIG. 213. *Thrasya* species. *T. campylostachya*: A, spike; *T. petrosa*: B, spike; C, portion of rachis with a pair of spikelets; *T. robusta*: D, portion of rachis with spikelets.

than the fertile lemma; lower lemma 2.2-2.8 mm. long, only slightly grooved in the middle, faintly 4-nerved, its palea stiff, equal to the lemma; lodicules 2, truncate; anthers 3, purple, 1.3-1.5 mm. long; upper floret ca. 2 mm. long, the lemma cartilaginous, minutely papillose in lines, its edges infolded over the margins of the equal flat palea; lodicules 2, truncate; anthers 3, purple; style branches 2, separate, naked two-thirds of their length. Chromosome number $n = 20$ from a Costa Rican specimen (reported as *T. gracilis* Swallen, which is probably not distinct).

Open brushy roadsides, savannas; Agua Caliente (Cartago), Cañas Gordas. Blooming June to February, possibly yearlong. Elevations 1,100-1,400 m. Southern Mexico to Bolivia.

Thrasya petrosa (Trin.) Chase, Proc. Biol. Soc. Wash. 24:115. 1911. *Panicum petrosum* Trin., Gram. Icon. 3, pl. 280. 1836. Figure 213.

Caespitose perennial; culms arching, up to 1.5 m. tall, branching from the base, 2-3 mm. thick, hollow, thin-walled, glabrous or appressed-pilose; nodes appressed-puberulent; sheaths nearly as long as the elongated internodes, from nearly glabrous to

strongly papillose-pilose with hairs up to 4 mm. long; ligule a brown membrane, up to 1 mm. long; blades very elongate, 4-6 mm. wide, papillose-pilose to nearly glabrous, the midrib very prominent beneath; leaf margins often revolute. Peduncles 1-several from the uppermost sheath, exerted up to 45 cm. Inflorescence a slender, arching raceme, 12-28 cm. long; rachis broadly winged, 4-5 mm. wide, clasping the basal parts of the spikelets. Spikelets ovate, acute, dorsally compressed, 4.5-5.5 mm. long, including the prominent, fleshy, oblique callus ca. 0.5 mm. long; first glume obsolete or up to 0.5 mm. long, thin, nerveless, deltoid; second glume 4.5-5.0 mm. long, faintly 5-nerved, appressed-hispid, ovate, acute; lower lemma 4.0-5.5 mm. long, stiff, appressed-hispid, ovoid, acute, 4-nerved, readily splitting down the deeply grooved middle; lodicules 2, truncate, fleshy; anthers 3, 1.8-2.2 mm. long, yellow to orange; pistil absent; palea equalling the lemma, stiff, acute, grooved down the middle, glabrous; upper floret with a stiff, dorsally flattened lemma, ovate 3:1, acute, minutely bearded at the apex, faintly 5-nerved, 3.5-4.0 mm. long; palea flat, stiff, 3.2-3.4 mm. long; lodicules 2, truncate, fleshy; anthers 3, smaller than those of the lower floret or apparently sometimes absent; style branches naked for ca. two-thirds of their length. Chromosome number $n = 20$ from a Costa Rican specimen.

Rare in Costa Rica; hilly savannas of the southern General Valley. July to December. Guatemala to Peru and Paraguay.

Thrasya robusta Hitchc. & Chase, Contr. U.S. Natl. Herb. 18:297. 1917. Figure 213.

Caespitose perennial, in dense clumps; culms up to 200 cm. tall, 2-4 mm. thick, hollow, appressed-pilose; nodes appressed-pilose; sheaths longer or shorter than the internodes, glabrous or with a few papillose bristles on the margins; ligule a brownish membrane, 2.0-2.5 mm. long; blades flat, keeled, up to 25 cm. long, 3-15 mm. wide, puberulent; collar more or less bearded with stiff, erect, white hairs; uppermost blade much reduced. Peduncles several from the upper sheath, slender, 5-20 cm. long; inflorescence a solitary, slender, arcuate raceme, 15-30 cm. long; rachis flat, 2.5 mm. wide, infolded around the bases of the spikelets, the margins sparsely fine-ciliate or glabrous, the tip extending beyond the spikelets as a naked point. Spikelets ovate 3:1, 3.3-4.5 mm. long, the fleshy white callus protruding at the base; first glume of one spikelet of the pair up to 1.5 mm. long, narrowly deltoid, 1-nerved, that of the other member very short and broad; second glume 3.0-3.5 mm. long, 5-nerved; lower lemma 3.0-3.5 mm. long, deeply grooved along the center and readily splitting; both second glume and lemma spreading-pilose; lower floret with 3 purple anthers ca. 1.5 mm. long; palea acute, stiff, grooved down the center, equal to the lemma; upper (fertile) floret 2.8-3.1 mm. long, the lemma cartilaginous, shining, minutely papillose in lines, minutely ciliate at the acute tip; palea similar and of equal length; stamens 3, purple; caryopsis elliptical 2:1, flat, whitish but purple at base and apex, 1.4-1.5 mm. long. Chromosome number $n = 30$ from a Costa Rican specimen.

This species is known in Central America only by the following two specimens: Guanacaste, along CIA, 15 km. SE of Liberia, elevation 100 m., 18 August 1968, *P. & D. 10946*; Puntarenas, between San Antonio and Boruca, elevation 740 m., 22 August 1968, *P. & D. 10798*. Trinidad; Costa Rica.

Thrasya trinitensis Mez, Repert. Sp. Nov. Fedde, 15:125. 1918. *T. paspaloides* of Hitchc., Man. Gr. W. Ind. 178. 1936, non H.B.K.

Caespitose perennial, in dense clumps; innovations densely villous; culms 30-65 cm. tall, erect, simple or branching from the lower nodes; prophylla 2 cm. long; culms glabrous, hollow, 1 mm. thick; nodes densely bearded with spreading hairs; leaf sheaths shorter than the internodes, keeled near the apex, papillose-pilose with long hairs and puberulent between them; ligule a stiff brown membrane, erose-ciliolate at the apex, 0.8-1.3 mm. long; leaf blades flat, strongly keeled beneath, the midrib depressed above, 5-9 cm. long, 1.5-3.0 mm. wide, the uppermost one much reduced, bearing stiff, elongated papillose-based hairs on the midrib, margins, and surfaces, and puberulent among the long hairs. Peduncles 1-4 from the uppermost sheath, slender, glabrous, or puberulent near the summit, bearded at the base of the raceme, exserted up to 20 cm.; inflorescence a solitary, slender, arched raceme, 2-5 cm. long; rachis flattened, up to 2 mm. wide, the margins foliaceous, the edges conspicuously papillose-ciliate with stiff, spreading golden hairs up to 2.5 mm. long; rachis tip extended up to 2 mm. beyond the terminal spikelet. Spikelets 2.5-2.8 mm. long, ovate, with a protruding basal callus, dorsally compressed, flattened on the first glume side, convex on the second glume side, rather open at the tip; first glume obsolete or a minute deltoid nerveless scale 0.3-0.5 mm. long; second glume ca. two-thirds as long as the spikelet, 1.3-1.7 mm. long, thin, ovate, faintly 3-nerved, villous toward the margins; lower (sterile) lemma 2.2-2.5 mm. long, ovate, acute, stiff, obscurely 4-nerved, deeply grooved along the center and readily splitting longitudinally into 2 separate segments, the tip and marginal flexures bristly; flower none; palea slightly shorter, stiff, acute, grooved down the middle; upper (fertile) floret 1.8-2.0 mm. long, elliptical, blunt, stiff, crested at the apex with a dense fringe of stiff cilia ca. 0.5 mm. long; margins of lemma inrolled over the edges of the flat palea; anthers 3, yellow, 1.5 mm. long; styles 2, free, naked for two-thirds of their length; caryopsis dorsally flattened, elliptical.

Rare; known in Costa Rica only from the following specimen: Indian Reserve above Buenos Aires de Osa, *R. Muñoz s.n.*, 24 August 1969.

This species has generally been known as *T. paspaloides*; however, the illustrations in H.B.K. indicate a plant with glabrous sheaths and without the long hairs on the leaf blades that our specimens show. The spikelets also lack the elongate bristles on the sterile lemma that the illustration and South American specimens have. *Thrasya trinitensis* occurs in Trinidad and in Belize, Nicaragua, and Costa Rica.

TRACHYPOGON Nees

Plants perennial, caespitose or with short rhizomes; culms unbranched, bearing solitary or rarely digitate terminal racemes of dimorphic spikelets. Spikelets paired, one of each pair short-pedicellate, persistent, awnless, staminate, dorsally compressed; other spikelet of each pair longer-pedicellate, deciduous, perfect-flowered, awned, nearly terete. Rachis of the raceme persistent after maturity of the spikelets, bearing the old staminate spikelets; awned perfect-flowered spikelets deciduous at maturity, falling with an oblique, hairy, pointed callus formed of the apical portion of the pedicel; first glume firm, narrowly elliptical, blunt, its margins inrolled over the second glume and mostly concealing it; second glume ca. as long as the first, somewhat keeled, 3-nerved, the apex clasping the base of the awn; lower (sterile) lemma hyaline, 2-nerved, grooved between the keels, the margins inflexed; fertile lemma narrow, firm except at the hyaline base, flattened, tapering directly into the base of the awn; awn twisted, hispid,

twice-geniculate, well-exserted; palea absent; styles 2, separate. Staminate spikelets with the first glume dorsally flattened, rounded on the back, 5-11-nerved, the margins sharply inflexed and covering the margins of a membranaceous second glume of about equal length; lower and upper lemma about equal, hyaline; anthers 3.

Trachypogon is a small genus of grasses of warm temperate and tropical climates of the Americas and Africa. Its closest relative is thought to be *Heteropogon*, which differs in having a disarticulating rachis. The taxonomy of the genus is in confusion, and a new monograph is in preparation by Dr. Davidse, who has kindly named our specimens. The awned pedicellate spikelets of *Trachypogon* are highly distinctive, and mimic the awned florets of species of *Stipa*. The similarity in appearance is the result of convergent evolution, and the two genera are widely separated taxonomically. (Panicoideae: Andropogoneae.)

KEY TO SPECIES OF *Trachypogon*

- 1a. Foliage glabrous or nearly so; ligules 2-10 mm. long; first glume glabrous
T. plumosus
 1b. Foliage, especially on lower parts of the plants, densely grayish woolly; ligules 1-3
 mm. long; first glume pubescent near the base *T. vestitus*

***Trachypogon plumosus* (Humb. & Bonpl. ex Willd.) Nees, Agrost. Bras. 344. 1829. *Andropogon plumosus* Humb. & Bonpl. ex Willd., Sp. Pl. 918. 1806.**

Plants perennial, densely caespitose in small clumps; culms erect, 65-150 cm. tall, unbranched; internodes cylindrical, glabrous, solid and pithy, 1-2 mm. thick; nodes impressed, upwardly bearded; leaf sheaths glabrous, the lower ones longer than the internodes; ligules adnate to the sheath margins, stiff, vasculated, pointed, 2-10 mm. long; leaf blades narrow and elongated, 2-4 mm. wide, narrowed to the base, flat or involute. Peduncles solitary, terminal, included or exserted up to 10 cm.; raceme slender, erect, 5-18 cm. long. Perfect-flowered spikelets 7.0-9.5 mm. long, including the sharp oblique hairy basal callus that is 1-2 mm. long; glumes ca. equal, the first coriaceous, narrowly elliptical, blunt at the apex, the back convex and the margins incurved, nearly covering the second glume, nerves 5-7; second glume nearly as long, keeled, 3-nerved, the obtuse apex embracing the base of the awn; lower (sterile) lemma hyaline, 2-nerved, nearly as long as the glumes, ciliate at the apex; upper (fertile) lemma reduced to the flattened stiff base of the awn; awn exserted 5-6 cm., twice geniculate, the basal 2 segments short-hispid and twisted; anthers 3, ca. 3 mm. long, yellow; styles 2, separate, naked below. Staminate spikelets borne on short pedicels, persistent after flowering, dorsally compressed, narrowly elliptical, ciliate at the obtuse apex; first glume rounded on the back, rather faintly 5-9-nerved, the margins sharply inflexed over the edges of the 3-nerved second glume; lower lemma hyaline, 4.5-5.5 mm. long; upper (fertile) lemma hyaline, 4-5 mm. long, narrowly elliptical, ciliate; anthers 3-6 mm. long, yellow.

Dry Curatella-Byrsonima savannas, often on volcanic tuff; mostly at elevations up to 400 m.; from Bagaces to the Nicaraguan border, Boruca and Paraíso savannas. July to December.

Trachypogon vestitus Anderss., Öfvers. Förh. Kongl. Svensk. Vetensk. Akad. 14:52. 1857.

Caespitose perennial in small clumps; plants 40-110 cm. tall, erect; culms unbranched; internodes 1-2 mm. thick, cylindric, pithy or hollow, glabrous; nodes densely upwardly bearded; foliage mostly aggregated near the base; leaf sheaths copiously hairy with soft, grayish trichomes; pubescence most prominent on the lower sheaths; ligule a stiff membrane, 1-3 mm. long, adnate to the sheath margins; leaf blades elongated, 2-5 mm. wide, flat or folded, usually densely grayish-pubescent with soft spreading hairs on both surfaces. Peduncles solitary, terminal, included or exserted up to 14 cm.; inflorescence a solitary terminal raceme, very slender, 5-23 cm. long. Awned spikelets 8-9 mm. long, including the callus, perfect-flowered, disarticulating with a very oblique, densely hairy basal callus; mature spikelets nearly terete in cross section; first glume 7-9-nerved, rounded on the back, the margins incurved and nearly concealing the second glume, blunt, lower portions of the back loosely pubescent; second glume ca. as long as the first, narrow, 3-nerved, with longitudinal grooves on both sides of the midrib; apex clasping the base of the awn; lower lemma hyaline, ciliate, ca. 6 mm. long; upper (fertile) lemma reduced to the stiff, flattened base of the awn; lodicules 2, truncate; anthers 3, yellow, ca. 3.8 mm. long; styles 2, separate, naked below, stigmas laterally exserted, brownish. Awnless spikelets 5.7-7.0 mm. long, staminate; first glume narrowly elliptical, blunt, 9-11-nerved, rounded on the back, loosely pubescent on the lower portion, its lateral flanges clasping the margins of the keeled, 3-nerved, ciliate second glume; lower lemma 5-6 mm. long, hyaline, ciliate; upper (fertile) lemma narrower, 4-6 mm. long, hyaline, faintly nerved; anthers 3, yellow, ca. 4 mm. long.

Rare; rocky savannas along the CIA, 2-3 km. S of La Cruz; elevation ca. 220 m. June to October.

TRINIOCHLOA Hitchcock

Caespitose perennials; leaf sheaths with united edges. Inflorescence a terminal panicle. Spikelets 1-flowered, disarticulating above the subequal, 1-nerved, purplish, usually short glumes; floret 1, slender, subcylindric; lemma faintly 7-9-nerved, the margins somewhat inrolled over the palea; callus oblique, bearded with straight erect hairs; apex of lemma acuminate, membranaceous, bidentate; awn inserted on the back, ca. one-third below the apex, geniculate, twisted below the first bend; palea firm, ca. as long as the lemma, nearly enveloping the narrowly cylindrical caryopsis, 2-nerved, the nerves very close together, scabrid, an indented purple line between them; rachilla not produced beyond the palea. (Pooideae: Meliceae.)

Triniochloa stipoides (H.B.K.) Hitchc., Contr. U.S. Natl. Herb. 17:303. 1913. *Podosaemum stipoides* H.B.K., Nov. Gen. & Sp. 1:131. 1816. Figure 214.

Caespitose perennial, the culms in small clumps, 50-135 cm. tall; culms glabrous, hollow, ca. 1 mm. thick; nodes glabrous; internodes elongated, mostly covered by the overlapping sheaths; sheaths 15-30 cm. long, prominently ribbed, scabrid or the lowermost puberulent; ligules prominent, membranaceous, lacerate, 5-10 mm. long; leaf blades 10-25 cm. long, 2-3 mm. wide, often folded, scabrid beneath, puberulent and with scattered long weak hairs above; peduncle up to 25 cm. long, puberulent; panicles solitary, terminal, 15-25 cm. long, open, pyramidal, with relatively few branches and

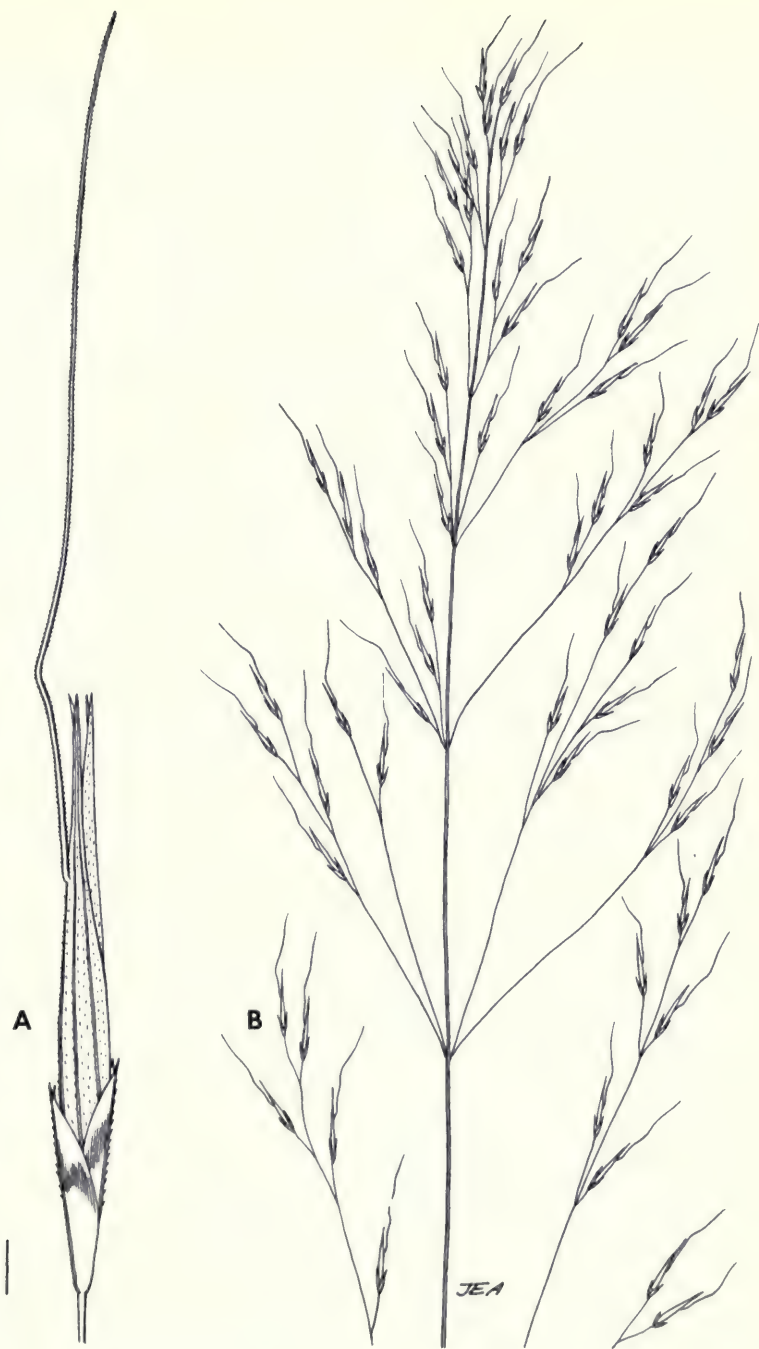


FIG. 214. *Triniochloa stipoides*. A, spikelet; B, panicle.

spikelets; the spikelets long-pedicellate, lying parallel to the branches, nearly terete, 11-13 mm. long; glumes subequal, purplish, ovate, acute, overlapping, much shorter than the floret, 1-nerved, the first 3.5-4.5 mm. long, the second 4-5 mm. long; floret subcylindric, 11-13 mm. long, firm, scabrid; lemma faintly 7-9-nerved; awn 15-20 mm. long; anthers 3, yellow, 4 mm. long. Chromosome number $n = 16$ from a Costa Rican specimen.

Rare, open areas, Irazú, 2,000-3,300 m.; near San Marcos, 1,900 m.; Chirripó Grande. Inflorescences have been seen on the plants from November to February. Mexico to Colombia, Venezuela, and Bolivia.

The genus is placed tentatively in the tribe Meliceae on the basis of its closed sheaths and basic chromosome number of $x = 8$.

TRIPLASIS Beauvois

Caespitose or rhizomatous annuals or perennials; spikelets borne in small terminal or axillary panicles; cleistogenes borne concealed in lower sheaths; spikelets several-flowered; disarticulation above the glumes and between the florets; glumes equal, 1-nerved; lemmas 3-nerved, bilobed, the midnerve projecting as a short awn; lateral nerves conspicuous, silky-pubescent, parallel to the midnerve; palea bowed out, the keels strongly villous-ciliate on the upper portion.

Triplasis is a genus of two species, native to the southeastern United States. It appears most closely related to *Tridens*, *Gouinia*, and *Leptochloa*. The habit of producing cleistogenes within the sheaths and the disarticulating culms are distinctive. (Chloridoideae: Eragrostaceae.)

***Triplasis purpurea* (Walt.) Chapm., var. *caribensis* Pohl**, Iowa State J. Res. 47:76. 1972. *Aira purpurea* Walt., Fl. Carol. 78. 1788. Figure 215.

Probably perennial; culms 60-75 cm. long, branching only at the base, in dense tufts; short rhizomes occasional; nodes appressed-pilose to nearly glabrous, not prominent; leaves 17 to 21 per culm, the blades successively shorter from base to apex of the culm; sheaths mostly overlapping, scabrid; ligule a dense ring of white hairs, 0.5-1.0 mm. long; lower blades 10-15 cm. long, 2-4 mm. wide, scabrid, the midribs not evident; uppermost blade much reduced, less than 1 cm. long. Peduncle included or exerted up to 3 cm.; exerted inflorescences terminal and axillary from upper nodes; terminal panicle few-branched, very open, with few spikelets appressed to the branches. Spikelets laterally compressed, 6-8 mm. long, disarticulating above the glumes and between the florets; first glume 2 mm. long, 1-nerved, lanceolate, bifid at the apex; second glume similar, 2.5-3.0 mm. long; florets 2-3; rachilla pilose at the apex of the internodes; lemma 3.6 mm. long, lanceolate, 3-nerved, the lateral nerves near the margin; lemma bifid ca. 1 mm. at the tip, with a minute awn arising between the teeth; nerves all finely ciliate; palea 2.7 mm. long, bowed outward, strongly ciliate on the upper third of the keels; anthers 3, 2 mm. long, purplish. Plants producing concealed cleistogenes at most nodes and disarticulating into separate internodes at maturity; cleistogenes usually 1-flowered. Cleistogene borne within a strongly folded rigid prophyllum and consisting of a single floret



FIG. 215. *Triplasis purpurea* var. *caribensis*. A, growth habit; B, a spikelet and two florets; C, terminal panicle.

with delicate and nearly glabrous lemma and palea; rachilla prolonged behind the palea as a minute bristle; glumes lacking. In some sheaths, a stiff peduncle bearing several more prophyllate cleistogenes occurs. No evidence of stamens can be found in the cleistogenes, suggesting that the production of the caryopses is apomictic. Chromosome number $n = 20$ from the type collection.

The plants are common on the sandy beach of the Caribbean at the Limón Airport, and at Playa Westfalia. They have been seen blooming from June to September, but may have a much longer blooming season. Type of the variety: Prov. de Limón, sandy open beach, between Limón Airport and the Río Banano along Caribbean Coast; elevation 2 m., scattered but forming an extensive stand, *Pohl & Davidse 11080*, 16 September 1969. Plants which are apparently identical were collected at Travesia, Puerto Cortes, Honduras (*Dickson 2017*, in EAP).

This variety is similar to *T. purpurea* var. *purpurea* of the United States, but differs in its taller and stouter culms, in the much larger number of leaf-bearing nodes, in the perennial habit and occasional production of rhizomes, and in the absence of the long, pustulose-based trichomes of var. *purpurea*.

TRIPSACUM Linnaeus

REFERENCES: H. Cutler & E. Anderson, A preliminary survey of the genus *Tripsacum*. Ann. Missouri Bot. Gard. 28:249-269. 1941. L. F. Randolph, Variation among *Tripsacum* populations of Mexico and Guatemala, Brittonia 22:305-337. 1970.

Stout erect perennials, the culms arising from short, thick rhizomes; internodes solid, maizelike; leaf blades large, broad, flat; inflorescences terminal on the main culm and axillary from the upper sheaths. Inflorescences spike-like, 1-many borne at the apex of each stout peduncle. Individual inflorescence a spike-like rame, the basal portion consisting of a series of thick, bony, hollow internodes, each enclosing a solitary pistillate spikelet; successive spikelets borne on opposite sides of the rachis, their first glumes closing off the hollow in which the remainder of the spikelet is hidden; individual internodes of the pistillate portion of the inflorescence separating at maturity, falling with the enclosed pistillate spikelets; upper portion of the rame with a flattened, jointed, non-disarticulating rachis, each internode bearing at its base 2 staminate spikelets, either both sessile or one pedicellate; all the staminate spikelets borne on the same side of the flattened rachis. Pistillate spikelets: First glume rigid, dorsally flattened, triangular-ovate, acute, closing off the hollow of the rachis completely, its margins sharply inflexed and clasping the second glume; second glume as long as the first, ovate, acuminate, firm, many-nerved; lower (sterile) lemma membranaceous, ovate, acuminate, with a hyaline palea; upper (fertile) lemma hyaline, its palea well-developed, nearly as long as the lemma; flower pistillate; ovary tapering into a short style; stigmas 2, linear, short-bearded for their full length. Staminate spikelets: Awnless, oblong, triangular in cross section; first glume facing away from the rachis, firm, many-nerved, its margins sharply inflexed, clasping the edges of the strongly-keeled, membranaceous, boat-shaped second

glume; florets 2, nearly equal; lemmas and paleas hyaline; lemma of lower floret flat, that of the upper floret keeled; paleas ca. equal to the lemmas; lodicules 2, truncate; anthers 3, large; ovary absent.

The genus *Tripsacum* is closely related to *Zea* (maize and teosinte) and has been experimentally crossed with it. The pistillate portion of the inflorescence is similar to the pistillate spike of teosinte. The basic chromosome number of *Tripsacum*, however, is $x = 9$ whereas that of *Zea* is $x = 10$. The pistillate spikelets are solitary, but those of maize are paired. *Tripsacum*, like *Zea*, is native only to the western hemisphere and is most diverse in the tropics, a single species extending northward to the midwestern United States. (Panicoideae: Andropogoneae.)

***Tripsacum laxum* Nash, N. Amer. Fl. 17:1:81. 1909.**

Tall, vigorous perennial, the culms to 4-5 m. tall, the bases becoming decumbent and rooting; internodes 2-3 cm. thick, solid, glabrous; nodes glabrous, dark; sheaths mostly overlapping, glabrous; ligule a thin membrane, ca. 1 mm. long; upper leaf blades up to 80 cm. long, 4-8 cm. wide; lower surface glabrous, the upper sparsely papillose-pilose near the base or merely papillose. Terminal inflorescences with 5-8 fascicled rames; axillary inflorescences usually of a single rame; individual rames with a basal portion usually 3-4 cm. long, consisting of 4-6 internodes bearing pistillate spikelets, the segments 6-9 mm. long, thick and rigid, shiny; pistillate spikelets 5-8 mm. long; staminate upper portion of the rame up to 30 cm. long; staminate spikelets paired, one subsessile and the other on a pedicel 3-4 mm. long; spikelets obovate, acute; first glume as long as the spikelet, dorsally flattened, 10-15-nerved, minutely hispid on the back, the margins scabrous-ciliate.

This species has been cultivated for forage in Costa Rica, and at times persists as a fence-row or roadside plant. We have collected semi-wild plants from the vicinities of Turrialba, Villa Neilly, and Barbacoas, at elevations from 600-1,100 m. The plants are apparently sterile, producing practically no good pollen. One of our specimens has the pistillate spikelets heavily infected with ergot. Dr. Randolph states that this species is known only from cultivation or as an escape.

The following other types of *Tripsacum* have been collected by us or recorded by others from Costa Rica.

***Tripsacum latifolium* Hitchc., Bot. Gaz. 41:294. 1906. (Atypical). Figure 216.**

The sparsely hispid leaf blades are much narrower than those of *P. laxum*, and have only a single rame on each peduncle. Chromosome number from this specimen was $n = 36$, with much meiotic abnormality, including formation of univalents and quadrivalents. Pollen was all sterile.

The above specimen, named as *T. latifolium* by Dr. Randolph, was collected on the beach of the Bay of Nicoya at Manzanillo (*P. & D.*

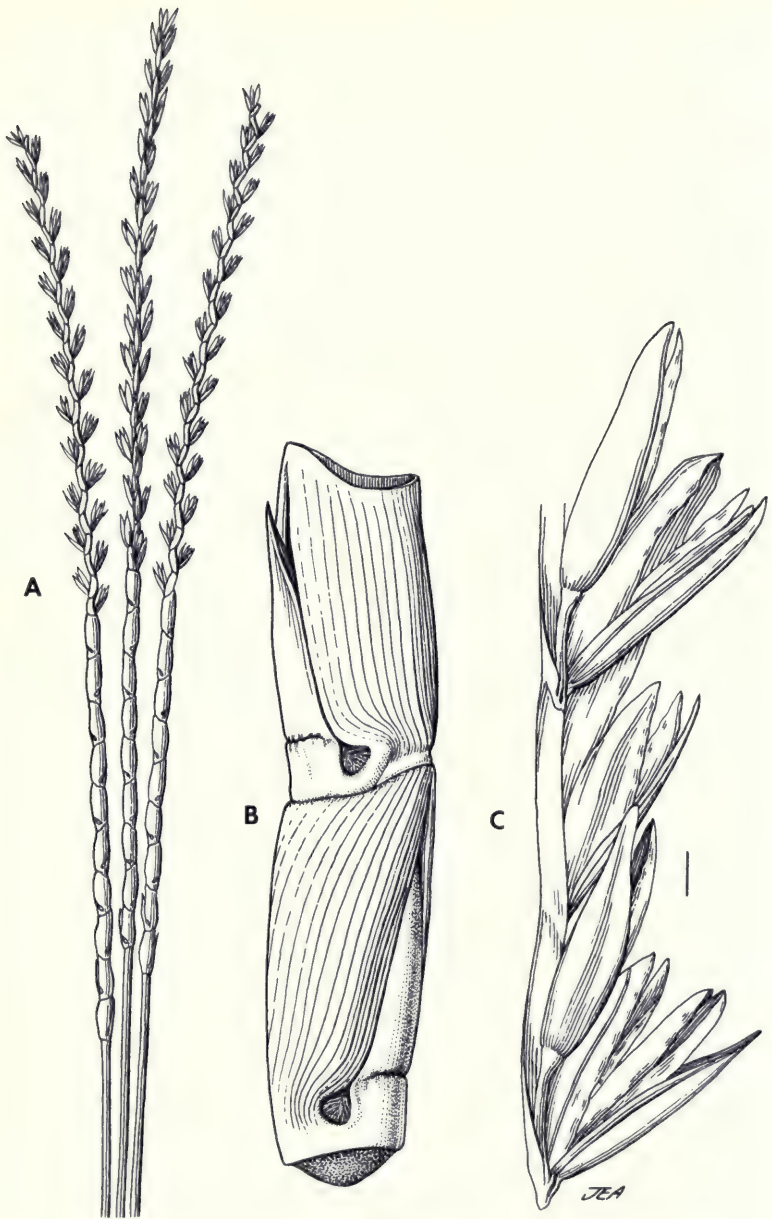


FIG. 216. *Tripsacum latifolium*. A, inflorescences with pistillate basal portions and staminate terminal parts; B, two segments of the pistillate rachis; C, portion of the staminate part of the rachis.

11624). The colony should be studied again and more complete material obtained.

Tripsacum maizar Hernandez & Randolph, Sec. Agric. Canad. (Mexico) Of. Est. Exp. Fol. Tecn. 4:7. 1950.

This species has densely hispid sheaths. The terminal inflorescences have numerous rames, and the staminate portions of the rames are elongate, slender, and drooping.

Two old cultivated specimens from Finca Las Concavas and the San José area are in the U.S. National Herbarium. The labels indicate that the plants bore the common name of *Maicillo*.

TRisetum Persoon

Tufted or rarely stoloniferous perennial grasses; inflorescence a terminal panicle. Spikelets laterally compressed, 2-several-flowered; glumes unequal or subequal, the second nearly as long as the spikelet, faintly nerved; disarticulation above the glumes and between the florets; lemmas faintly 5-nerved, awned from the back above the middle, or nearly awnless in one species; the apex 2- or 4-toothed; paleas slightly shorter than the lemmas; rachilla prolonged above the uppermost floret as a usually hairy bristle.

A genus of ca. 75 species, in temperate and cold climates of both hemispheres, related to *Deschampsia* and *Aira*. (Pooideae: Aveneae.)

KEY TO SPECIES OF *Trisetum*

- 1a. Awn minute, straight, not exerted from glumes *T. pringlei*
- 1b. Awn conspicuous, usually longer than lemma, geniculate and well exerted from glumes 2
- 2a. Panicle open, pyramidal, branches verticillate, naked at base; lemmas 4-toothed at apex *T. tonduzii*
- 2b. Panicles slender, narrowly cylindrical, the branches appressed, mostly bearing spikelets to their bases; lemmas not 4-toothed 3
- 3a. Glumes shorter than florets, the first narrow, 1-nerved, second ovate, 3-nerved; lemmas scabrous-roughened *T. irazuense*
- 3b. Glumes nearly as long as spikelet, equal, linear, 1-nerved; lemmas smooth, glabrous *T. deyeuxioides*

Trisetum deyeuxioides (H.B.K.) Kunth, Rév. Gram. 1:102. 1829.
Avena deyeuxioides H.B.K., Nov. Gen. & Sp. 1:147. 1816. Figure 217.

Caespitose perennial, in small clumps; culms leafy, slender and weak, unbranched, hollow, thin-walled, glabrous, the bases often decumbent; nodes glabrous, dark, not prominent; sheaths ca. as long as the internodes, glabrous or the lower weakly pubescent; ligule a lacerate-ciliolate membrane, 0.5-3.5 mm. long, one side decurrent onto the sheath margin; blades lax, 8-16 cm. long, 2-6 mm. wide, usually glabrous, scabrid. Panicle solitary, terminal, loose and nodding, 10-20 cm. long, 1-4 cm. wide, the branches up to 7 cm. long, ascending, densely covered with spikelets; aspect plummy because of the abundant long hairs of the rachilla segments. Spikelets numerous, appressed along the branches of the panicles, laterally compressed, 5-6 mm. long, 2-flowered, disarticulating

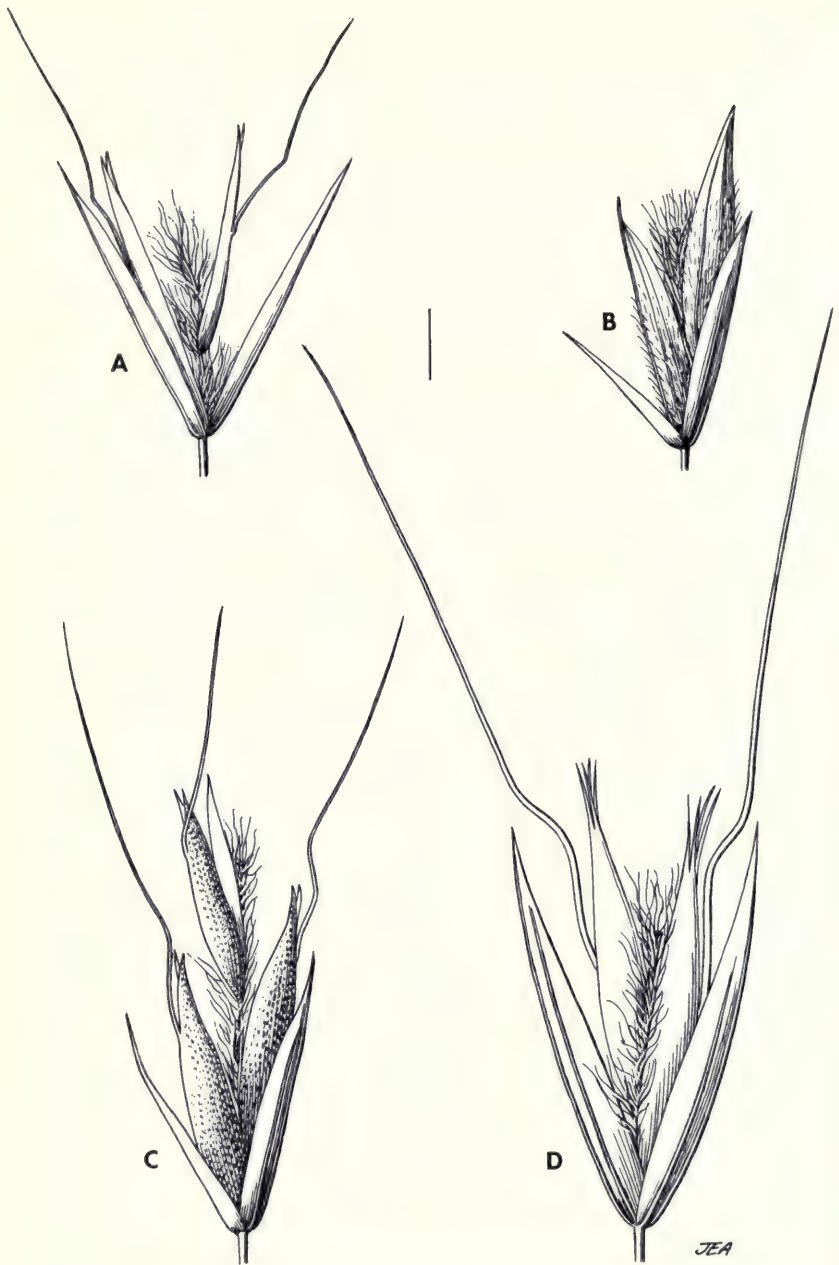


FIG. 217. *Trisetum* species. *T. deyeuxioides*: A, spikelet; *T. pringlei*: B, spikelet; *T. irazuense*: C, spikelet; *T. tonduzii*: D, spikelet.

above the glumes and at the base of the second floret; glumes linear, equal, nearly as long as the spikelet, 1-nerved, scabrous on the keel, folded, acute, the keel greenish, the margins silvery or purple; first glume 4.2-5.5 mm. long, the second 4.9-5.5 mm. long; florets 2; lemmas narrowly lanceolate, the lower 4.2-5.0 mm. long, the upper shorter, rounded on the back, bidentate at the tip, glabrous; callus oblique, sparsely short-bearded with hairs up to 0.5 mm. long; awn 5-7 mm. long, inserted about the middle of the back, geniculate, exserted from the glumes, the basal segment loosely contorted; palea nearly as long as the lemma; rachilla segments slender, ca. 1.5 mm. long, the apex with abundant silky white hairs up to 3 mm. long; anthers 2, 1.5 mm. long, yellow; caryopsis linear, soft, the endosperm remaining pasty. Chromosome number $n = 14$ from Costa Rican material.

Occasional in moist open places, especially along roads and in brush, in and around the Meseta Central; elevations from 1,100-2,500 m.; June to November. Mexico, Guatemala, Honduras, Costa Rica, Panama, to Ecuador.

Trisetum irazuense (Kuntze) Hitchcock, Proc. Biol. Soc. Wash. 40:82. 1927. *Calamagrostis irazuensis* Kuntze, Rev. Gen. Pl. 2:763. 1891. *T. scabriflorum* Hitchc., Contr. U.S. Natl. Herb. 24:358. 1927. Figure 217.

Perennial; 45-105 cm. tall; culms unbranched, erect, or the bases decumbent and rooting, 1-2 mm. thick, hollow, mostly glabrous, or retrorsely pubescent below the dark, contracted nodes; sheaths more or less retrorsely pilose, sometimes densely so; ligule membranaceous, 1-3 mm. long, sometimes hairy on the back, decurrent on the sheath margin; blades flat, 10-33 cm. long, 2-5 mm. wide, more or less pilose on both surfaces, the uppermost blade often reduced. Peduncle slender, up to 30 cm. long; inflorescence terminal, solitary, a narrow, somewhat loose panicle, nodding, 13-30 cm. long, 1-3 cm. wide, the branches ascending, up to 6 cm. long, naked at the base, rather densely flowered; spikelets appressed along the branches, overlapping, borne on pedicels of varying lengths. Spikelets narrow, 6-9 mm. long, with 2-4 florets; first glume 3-5 mm. long, narrowly triangular, 1-nerved, scabrous on the upper half of the keels; second glume narrowly obovate, 3.8-6.5 mm. long, 3-nerved, green between the nerves and with a broad whitish margin; lowermost lemma 4.3-6.0 mm. long, the others successively shorter, the terminal as short as 3.0 mm.; lemmas lanceolate, shortly bidentate at the apex, rugose and scabrous all over the rounded back; callus hairs scanty, ca. 0.5 mm. long; awn 6-9 mm. long, inserted ca. one-third below the apex, geniculate; paleas slightly shorter than their lemmas; rachilla internodes slender, bearded, 1.7-2.0 mm. long, the hairs longest at the apex, ca. 1.5 mm. long; anthers 3, 1.0-1.3 mm. long, tan. Caryopsis soft, the endosperm pasty.

Pastures and devastated areas, Irazú and Turrialba; 2,600-2,800 m. elevation. August to November. Mexico to Panama; Colombia and Venezuela to Ecuador.

Several of our recent specimens from Irazú are vegetatively much larger and more vigorous than the specimens from Turrialba, possibly because of the increased soil fertility added by the eruption of Irazú.

Trisetum pringlei (Scribn.) Hitchc. Proc. Biol. Soc. Wash. 40:82.

1927. *Grappophorum pringlei* Scribn. in Beal, Gr. N. Amer. 2:561. 1896. Figure 217.

Perennial, in small clumps; plants erect, 30-80 cm. tall; the culms erect or with decumbent bases, unbranched, slender, hollow, glabrous; culm nodes 2, dark, contracted, one near the base, the other at midculm; sheaths elongated, glabrous or retrorsely puberulent or velvety; ligules membranaceous, erose, 1-2 mm. long, prolonged into a sheath auricle on one side; blades mostly basal, 4-12 cm. long, 2-5 mm. wide, more or less puberulent beneath, longitudinally ridged and scabrous above, often involute. Peduncle 5-15 cm. long; panicle solitary, terminal, slender but nodding, the branches whorled, ascending, up to 8 cm. long, naked near the base; spikelets mostly short-pedicellate, appressed to the branchlets, often purplish. Spikelets narrowly oblong, laterally compressed, 4.5-6.5 mm. long, disarticulating above the glumes and between the florets; first glume narrowly ovate, acute, 1-nerved, 1.5-2.6 mm. long; second glume narrowly ovate to oblong, acute, 3-nerved, 3.5-4.5 mm. long; florets 2-3, the lemmas rounded on the back, scabrous or short-pubescent on the lower two-thirds of the back, 5-nerved, often purplish above, tapering to an acute apex, awnless or with a short straight awn less than 1 mm. long just below the apex; lowermost lemma 3.6-4.0 mm. long, the upper ones successively shorter, to 2.8 mm. long; paleas ca. three-fourths as long as the lemmas, scabrid on the keels; rachilla internodes bearded, ca. 1.5 mm. long, the terminal one to two-thirds as long as its lemma; anthers 3, purple, 0.7-1.2 mm. long. Chromosome number $n = 14$ from Costa Rican material.

This species has been collected from the upper cinder cone of Irazú, and from páramos of Cerro Asunción, Cerro Buena Vista, and Chirripó Grande, at altitudes of 3,150-3,400 m. Blooming from June to December. The population from Irazú has pronouncedly pubescent lemmas, whereas those from the Cordillera de Talamanca population are much less so. Southern Mexico and Guatemala; Costa Rica; Volcán Chiriqui, Panama.

***Trisetum tonduzii* Hitchc., N. Amer. Fl. 17:558. 1939. Figure 217.**

Perennial; plants 45-85 cm. tall; culms erect, or in very moist places, becoming decumbent and trailing, terminating in dense moplike clusters of foliage, with new culms arising from them; branching from the bases of the culms. Culms hollow, glabrous, the nodes dark, glabrous; sheaths glabrous or occasionally slightly retrorsely hispid on the collar, mostly overlapping; ligule membranaceous, lacerate-ciliate, decurrent on one sheath margin, 1.5-3.0 mm. long; blades firm, up to 21 cm. long, 4-6 mm. wide, glabrous or loosely pubescent above, often becoming involute, especially toward the apex. Peduncle glabrous, 6-10 cm. long; panicles ovoid-pyramidal, many-flowered; branches verticillate, up to 7 per node, naked below, rather densely flowered on the outer two-thirds. Spikelets laterally compressed, 4.5-6.5 mm. long; glumes subequal, 4.0-6.5 mm. long, usually purple, lanceolate, acute or awn-tipped, the first 1-3-nerved, the second 3-nerved; florets 2; lower lemma 3.8-6.0 mm. long, lanceolate, rounded on the back, slightly scabrid, usually purple toward the tip, the nerves faint; apex bifid above the insertion of the awn, each lobe acuminate and terminating in 2 awnlike teeth; awn geniculate and loosely spiral, 7-13 mm. long, well exerted from the spikelet; upper floret similar but smaller, its lemma 2.8-5.0 mm. long; callus of the lemmas strongly white-bearded, the hairs ascending, up to half the length of the lemma; rachilla segments white-bearded, especially near the summit; sterile rachilla segment above the second

lemma ca. 2 mm. long; paleas slightly shorter than the lemmas; anthers 3, 1.7-2.0 mm. long, purple. Caryopsis soft, the endosperm pasty. Chromosome number $n = 14$ from Costa Rican material.

This handsome species occurs near the craters of Poás, Irazú, and Turrialba, at elevations of 2,600-3,400 m. It grows on volcanic mud and cinders and in meadows, often on steep slopes. It was characterized by Hitchcock as being rhizomatous. Our observations suggest, rather, that the culms become decumbent and finally produce dense fascicles of foliage near their tips. June to August. Endemic to the volcanoes of the Meseta Central.

UNIOLA Linnaeus

REFERENCE: H. O. Yates, Revision of grasses traditionally referred to *Uniola*, I. *Uniola* and *Leptochloöpsis*. Southwestern Nat. 11:372-394. 1966.

Harsh perennial beach grasses, stoloniferous or rhizomatous; spikelets in panicles, strongly compressed and keeled; disarticulation below the glumes; glumes subequal, shorter than the lowermost floret, acute, 3-nerved; glumes and lemmas all compressed-keeled; lower 2-6 lemmas empty; lemmas broad, acute, strongly keeled, chartaceous, 3-9-nerved; palea bowed, shorter than the lemma. (Chloridoideae: Unioleae.)

Uniola pittieri Hackel, Oesterr. Bot. Z. 52:309. 1902. Figure 218.

Stout stoloniferous perennial; culms 75-150 cm. tall, unbranched, erect; stolons stout, extensive, abundant, up to 18 m. long; culms 3-4 mm. thick, hollow, glabrous; nodes glabrous, not prominent, rarely exposed; leaf sheaths mostly longer than the internodes, overlapping, glabrous except for ciliolate upper margins; collar dark, sometimes puberulent; auricular hairs prominent, cottony; ligule a dense circle of hairs, ca. 1 mm. long; leaf blades coriaceous, flat, tapering to a long involute tip, up to 70 cm. long and 15 mm. wide, scabrous, glabrous except for some pubescence just above the ligule, strongly ridged above; leaves about 6-7 per culm. Peduncle solitary, terminal, included or exserted up to 20 cm., cylindrical, hollow, glabrous; panicle rather dense, cylindrical, narrow, about 20-40 cm. long; rachis and branches angular, scabrid; spikelets very numerous, densely overlapping along the short, ascending branches, borne in 2 rows along the lower sides of the branches, subsessile, the pedicels 1 mm. long or less; disarticulation below the glumes only; spikelets 8-25 mm. long, very strongly laterally compressed, the lemmas and glumes winged, especially near the tips; glumes 3-6 mm. long, lanceolate, 3-nerved, acute; florets 10-20, the lower several empty and without paleas; most of the florets sterile; lemmas 4.5-5.5 mm. long, ovate, acute, the keel incurved; nerves usually 5, green-striped when young; glabrous but the margins minutely ciliolate; keel scabrous; palea strongly bikeeled, the nerves conspicuous, the keels ciliolate; anthers 3, 2-3 mm. long, yellow; caryopses not seen. Chromosome number $n = 20$ from a Costa Rican specimen.

Uniola pittieri is common on sandy beaches along the Pacific Coast and has been collected from the area of Puerto Limón. Inflorescences may be found on the plants at almost all seasons of the year. Baja California to Ecuador and Colombia, on sea beaches.



FIG. 218. *Uniola pittieri*. Panicle, spikelet, stolon, plant base.

Like the North American *U. paniculata*, this species appears to be almost sterile, reproducing primarily by the very extensive stolons. The inflorescences are decorative and are sometimes sold in stores, either in the natural state or gilded. The plants are valuable as sand binders on the low dunes just back of the storm beaches.

UROCHLOA Beauvois

Leaf blades flat, broad; inflorescence a panicle of simple one-sided racemes, the spikelets short-pedicellate, solitary or paired in 2 rows along the lower sides of a triquetrous rachis, with their first glumes turned away from the midrib of the rachis. Spikelets disarticulating below the glumes, dorsally compressed, ovate, awnless; first glume much shorter than the spikelet; second glume and lower (sterile) lemma subequal, as long as the spikelet, 5-7-nerved in our species; lower lemma with a palea ca. as long, and a staminate flower; upper (fertile) floret slightly shorter than the lower one, elliptic, the lemma stiff or rigid, rugulose, terminating in a short mucro; palea of similar length and texture; lodicules 2; anthers 3; styles separate; caryopsis elliptical, with a large embryo.

Tropics of the Old World, with the exception of the following introduced species. About 20 species. The genus is closely related to *Brachiaria*, but the position of the spikelets is reversed, the first glumes of the spikelets facing outward, and the fertile lemmas are mucronate. Also, the following species has a chromosome number base of $x = 7$, which occurs in other species of *Urochloa*, whereas that of *Brachiaria* is usually $x = 9$. (Panicoideae: Paniceae.)

***Urochloa reptans* (L.) Stapf, Fl. Trop. Africa 9:601. 1920. *Panicum reptans* L., Syst. Nat. 10:870. 1759. *Brachiaria reptans* (L.) Gard. & C. E. Hubb., Hook. Icon. Pl. 3363:3. 1938. Figure 219.**

Duration indefinite; culms decumbent and rooting from the nodes of the prostrate portions; erect branches 10-40 cm. long; internodes 1 mm. or less thick, hollow, thick-walled, glabrous; nodes elongate, light-colored, puberulent; leaf sheaths much shorter than the internodes, finely and densely papillose-ciliate on the overlapping margin, the surfaces glabrous or sparsely papillose-hispid; ligule a short, densely ciliate membrane, in total 0.7-1.0 mm. long; leaf blades cordate-ovate 2.5-7.5:1, 2.5-6.5 cm. long, 6-10 mm. wide; margins prominently papillose-hispid ciliate on the cordate base, the surfaces glabrous, sparsely papillose-hispid or puberulent; margins with a thick band of sclerenchyma. Peduncle 3-11 cm. long; inflorescences terminal on leafy branches, 4-6 cm. long and ca. as wide, composed of 3-10 short ascending racemes, 1-3 cm. long, solitary or paired along the central rachis; racemes simple or with short secondary branches near the base; spikelets paired or solitary along the lower 2 sides of the triquetrous scabrous rachis; pedicels short, unequal, scabrous or bearing a few papillose-based hairs. The orientation of spikelets is with the first glume outward when the spikelets are solitary; arrangement is less definite when they are paired or clustered. Spikelets 1.8-2.1 mm. long, ovate 2:1, acute, glabrous; first glume 0.3-0.5 mm. long, blunt, collar-like, nerveless; second glume and lower (sterile) lemma equal, as long as the spikelet; second glume 7-nerved; lower lemma 5-nerved, with an equal palea and a staminate flower; upper

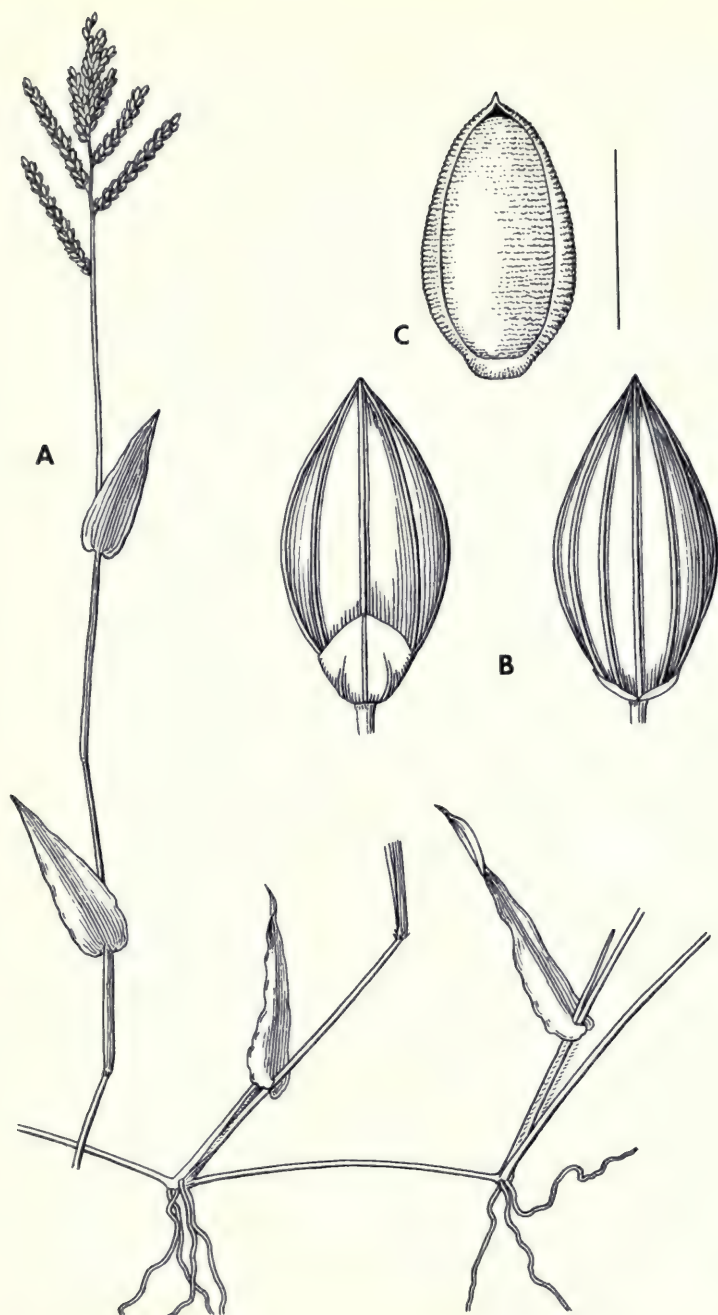


FIG. 219. *Urochloa reptans*. A, blooming plant; B, two views of a spikelet; C, fertile floret.

(fertile) lemma elliptical 1.7:1, rigid, rugulose, 1.6-1.7 mm. long, with a definite mucro ca. 0.1 mm. long; areole (germination lid) visible at the base of the lemma; palea of equal length and similar texture; lodicules 2, truncate; anthers 3, yellow-orange, 0.7-1.0 mm. long; style branches naked below; stigmas purple; caryopsis broadly elliptical 3:2, whitish, ca. 1.2 mm. long, with a large embryo. Chromosome number $n = 7$ from a Costa Rican specimen.

Occasional at low elevations below 100 m. in Guanacaste, mostly near the Pacific Coast; open roadsides, savannas. June to October. Introduced from the Old World; southern United States, eastern Mexico, El Salvador, Costa Rica; West Indies and northern South America.

VETIVERIA Bory

Densely caespitose tall perennial, forming large clumps; basal leaves abundant, stiff, erect, folded; flowering rare; inflorescence a large solitary terminal panicle of verticillate stalked rames. Spikelets paired at each node of the disarticulating rachis, one sessile and one pedicellate. Spikelets laterally compressed, echinate, awnless, the members of each pair equal and fertile. (Panicoideae: Andropogoneae.)

Vetiveria zizanioides (L.) Nash, in Small, Fl. S.E. U.S. 67. 1903. *Phalaris zizanioides* L., Mant. Pl. 183. 1771. *Anatherum zizanioides* (L.) H. & C., Contr. U.S. Natl. Herb. 18:285. 1917. *Chrysopogon zizanioides* (L.) Roberty, Mon. Androp. 291. 1960. Figure 220.

Perennial in large dense clumps; foliage mostly basal, the leaf sheaths closely overlapping, strongly compressed and keeled; ligules densely ciliate, 0.5-1.5 mm. long; leaf blades scarcely distinguished from the sheaths, stiff and erect, folded, with a conspicuous keeled midrib below, the basal blades up to 1 m. or more long, 6-8 mm. wide; sheaths and blades glabrous except for the upper leaf surface just above the ligule. Culms rarely produced, up to 2 m. tall, solid, somewhat compressed, their leaves shorter than the basal ones. Inflorescence a solitary terminal panicle of rames, borne on a glabrous peduncle up to 50 cm. long; panicle open-cylindrical, with numerous verticillate ascending slender branches (rames), the longer ones up to 10 cm. long; spikelets paired, one sessile and one pedicellate, at each node of the readily disarticulating rachis. Spikelets lanceolate, purplish; glumes stiff, echinate with short, stiff, pustulose-based bristles in lines along the keels and lateral nerves, equal, 3-5-nerved, 4.0-5.5 mm. long, completely concealing the florets; lower floret sterile, consisting of a membranaceous, faintly 3-nerved narrowly lanceolate lemma, slightly shorter than the glumes; fertile upper floret with membranaceous, faintly nerved narrow lemma shorter than the lower lemma, and a linear palea ca. half as long as the lemma; lemma tip sometimes bifid and with a minute awn tip arising between the teeth; lodicules 2, truncate, fleshy; anthers 3, yellow, 1.8-2.0 mm. long; style branches naked below. Chromosome number $n = 10$ from a Costa Rican specimen.

Commonly used as a hedge plant in the Meseta Central, planted along the top of road embankments in a continuous row, to prevent erosion. Usually cultivated, but volunteer colonies, apparently from seed, may be found near cultivated stands. Blooming is rare, but we

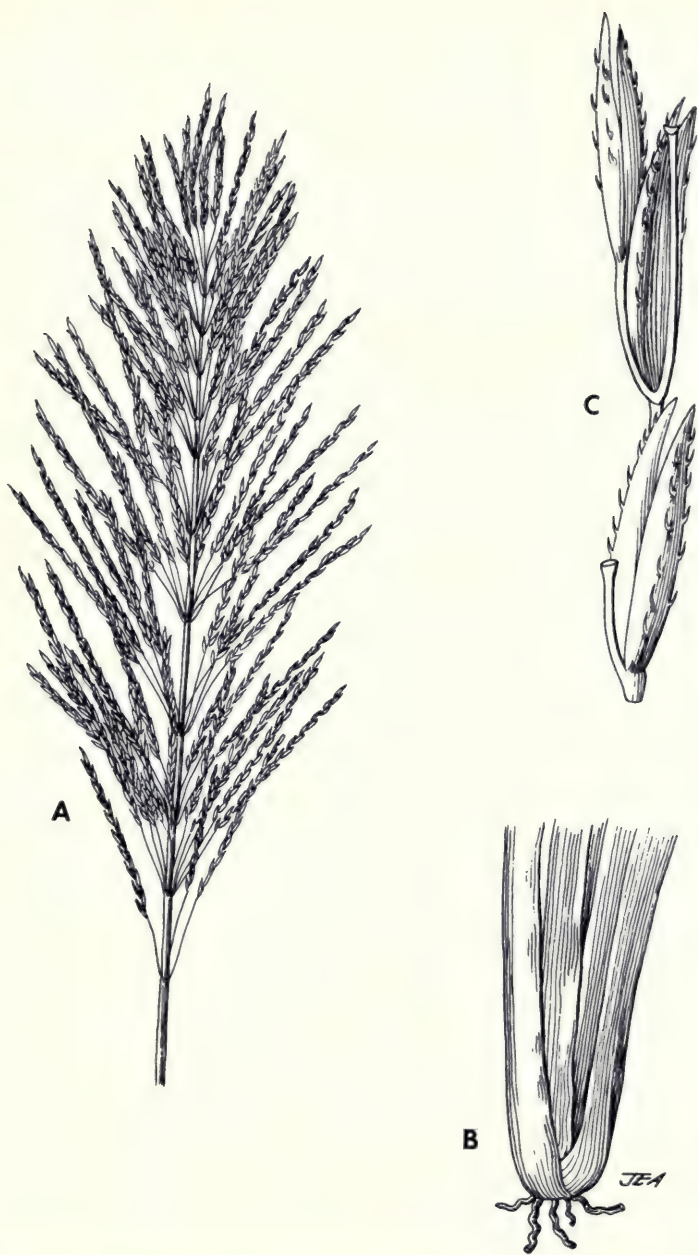


FIG. 220. *Vetiveria zizanioides*. A, panicle of rames; B, culm base; C, segment of a rame, with sessile and pedicellate spikelets.

have two blooming specimens, one from Guayabo, and the other from Venecia. Low to middle elevations. October to January.

This Asiatic species is cultivated in warm climates. The roots can be used to produce a perfume (vetiver or khus-khus). It is naturalized to some extent in the southern United States and the Caribbean Islands. We have specimens from Honduras and Costa Rica.

VULPIA Gmelin

REFERENCES: J. Henrard, A study in the genus *Vulpia*, Blumea 2:299-326. 1937. R. I. Lonard & F. W. Gould, The North American species of *Vulpia* (Gramineae), Madroño 22:217-230. 1974. E. Paunero, Notas sobre gramineas 2. Consideraciones acerca de las especies españolas del genero *Vulpia* Gmel., Anales. Inst. Bot. Cavanilles 22:81-114. 1964.

Slender tufted annual grasses; inflorescence a solitary terminal panicle; spikelets with several florets; glumes shorter than the florets, the first shorter and narrower than the second, 1-nerved, the second usually 3-nerved; lemmas slender, with a hard callus, often with inrolled margins, obscurely 5-nerved, tapering into a slender awn; palea nearly as long as the lemma; anther one, usually retained within the cleistogamous floret.

About 25 species, especially numerous in Mediterranean Europe, western North America, and South America. The genus is closely related to *Festuca*, from which it differs in having annual species with a single anther and predominantly cleistogamous reproduction. Hybrids between the two genera have been reported. (Pooideae: Poeae.)

KEY TO SPECIES OF *Vulpia*

- 1a. Lemmas ciliate on upper margins *V. myuros* var. *hirsuta*
- 1b. Lemmas not ciliate *V. bromoides*

***Vulpia bromoides* (L.) S.R. Gray**, Natur. Arrange. Brit. Pl. 2:124. 1821. *Festuca bromoides* L., Sp. Pl. 75. 1753. *Festuca dertonensis* (All.)Asch. & Graebn., Syn. Mitteleurop. Fl. 2:558. 1901. Figure 221.

Short-lived annual, in small clumps; plants 20-65 cm. tall; culms erect or with decumbent bases, slender, glabrous, hollow, unbranched or branching just above the base; prophylla prominent, up to 22 mm. long; foliage scanty, mostly basal; culms with 2 nodes; sheaths shorter than the internodes, glabrous; ligule a minute membranaceous fringe; blades flat or folded, soft and weak, 3-7 cm. long, ca. 1 mm. wide, puberulent above. Peduncle long-exserted, 15-25 cm. long, slender, glabrous; panicle solitary, terminal, slender, 2-12 cm. long, the short branches paired or solitary, erect and appressed to the rachis, few-flowered, the spikelets mostly overlapping. Spikelets 7-10 mm. long, excluding the awns; first glume 2.3-4.3 mm. long, subulate, 1-nerved; second glume narrowly lanceolate, 3-nerved, 4.6-6.7 mm. long; florets 4-7; lemmas narrowly lanceolate, 5.5-7.0 mm. long, with inrolled margins, faintly 5-nerved, glabrous or scabrid above, tapering into an awn 7-10 mm. long; palea nearly as long as its lemma; anther single, 0.4-1.5 mm. long. Chromosome number $n = 7$ from Costa Rican material.



FIG. 221. *Vulpia* species. *V. bromoides*: A, panicle; B, spikelet; *V. myuros* var. *hirsuta*: C, spikelet; D, floret.

Disturbed open areas, cinder slopes, roadsides; probably blooming yearlong; elevations 2,000-3,000 m. Introduced from Europe; western United States and Canada, Baja California, Guatemala, South America.

Vulpia myuros (L.) K. Gmelin, var. **hirsuta** Hack., Cat. Gram. Port. 24. 1880. *Festuca myuros* L., var. *hirsuta* (Hack.) Asch. & Graebn., Syn. Mitteleurop. Fl. 2:558. 1901. *Vulpia megalura* (Nutt.) Rydb. Bull. Torrey Bot. Club 36:538. 1909. *Festuca megalura* Nutt., Acad. Philadelphia II:1:188. 1848. Figure 221.

Short-lived annual, caespitose, erect in small clumps, 10-70 cm. tall; culms unbranched, ca. 1 mm. thick, hollow, glabrous; nodes glabrous; sheaths glabrous, auricled; ligule a short membrane, 0.2-0.7 mm. long; blades mostly 10 cm. or less long, 1-2 mm. wide, folded or involute, glabrous or the upper surface puberulent. Inflorescence a slender, erect terminal panicle, 5-20 cm. long, the branches appressed; spikelets mostly very short-pedicelled, appressed to the branches. Spikelets 8-10 mm. long, excluding the awns; first glume acicular, 1-nerved, 0.2-2.0 mm. long; second glume subulate, 1-nerved, 3.0-4.5 mm. long; lemmas narrowly lanceolate, scaberulous in lines, obscurely 5-nerved, their upper margins conspicuously ciliate with soft hairs; lowermost lemma 5.5-8.0 mm. long, the upper ones successively shorter, their apices usually at one level; awns 7-17 mm. long; paleas ca. three-fourths the length of the lemmas, scabrous on the keels; anther 1, purplish, 0.3-1.2 mm. long. Chromosome number $n = 21$ from the Costa Rican material.

Cultivated field, San Juan de Chicao, Irazú. November. Introduced from Europe. This species is widespread in western United States and is known from Mexico and Guatemala. The Costa Rican occurrence probably represents a recent introduction, since it is from the same site as our only collections of *Nassella linearifolia* and *Muhlenbergia ramulosa*, both Mexican species.

ZEA Linnaeus

Tall caespitose annual grass with thick, solid culms, often reaching a height of 3-5 m. Monoecious, with the staminate spikelets borne in a terminal panicle inflorescence made up of several to many rames bearing paired staminate spikelets, one member of each pair sessile or subsessile and the other pedicellate; glumes of staminate spikelets soft, herbaceous, many-nerved, equal, concealing the 2 hyaline equal florets; flowers with 3 large anthers. Pistillate spikelets borne on an axillary spike (cob, mazorca) that is covered and concealed by numerous overlapping bracteal leaves, only their elongated styles or silks protruding at the tip; spikelets paired, borne in longitudinal rows, covering the entire surface of the cob; compression dorsal; first glume, second glume, and lower (sterile) lemma represented by small scales or chaff on the surface of the cob; lower floret without a flower except in unusual strains; upper floret developing an enlarged naked kernel that very tardily disarticulates, usually only by human action, from the remainder of the spikelet, leaving the bracts on the cob; kernels usually mutually compressed and becoming angular at maturity; style 1, becoming the elongated "silk," without evidence of separate stigmas.

***Zea mays* L., Sp. Pl. 971. 1753.**

This is the common maize of the Americas, of which a myriad of strains exist. Tropical forms, such as are planted in Costa Rica, are very tall and slow-growing, the culms often being supported by numerous prop roots. The species is unknown except in cultivation, although wild maize [*Zea mexicana* (Schrad.) Reeves & Mangelsd.] occurs from southern Mexico to Honduras. This is commonly called *teosinte* and may occasionally be cultivated.

ZEUGITES P. Browne

Perennial grasses; leaf blades tessellate, borne on pseudopetioles; inflorescence a panicle; spikelets several-many flowered, disarticulating below the glumes; lowermost floret pistillate, all the others staminate; glumes tessellate, the first broader than the second.

The only close relative of *Zeugites* in Central America is *Orthoclada*. Both genera have uncinat microhairs on the epidermis. (Arun-dinoideae: Centosteeceae.) In classical Latin, the name *Zeugites* was regarded as masculine. By common taxonomic usage, it has been used as feminine.

KEY TO SPECIES OF *Zeugites*

- 1a. Leaf blades 25-45 cm. long, 4-7 cm. wide; culms 1-4 m. tall, erect to arching
Z. pittieri
- 1b. Leaf blades 2-5 cm. long, 1-2 cm. wide; culms weak, decumbent
Z. mexicana

***Zeugites mexicana* (Kunth) Trin. ex Steud., Nom. Bot. ed. 2. 2:798. 1841. *Senites mexicana* (Kunth) Hitchc., Contr. U.S. Natl. Herb. 17:370. 1913. *Despretzia mexicana* Kunth, Rév. Gram. 2:485. Pl. 157. 1831. Figure 222.**

Sprawling perennial, occasionally rhizomatous in litter; branching profuse, often with several branches from one axil; prophylla prominent, 1.5-2.0 cm. long; culms 1-2 mm. thick, hollow, smooth and shining, glabrous, brownish; leaf sheaths shorter than the internodes, glabrous or hirsute; ligule 1-2 mm. long membranous, sometimes hirsute on the back; leaf blades borne on slender pseudopetioles 7-10 mm. long, with a purplish hairy pulvinus below the apex; blades ovate, flat, 2.5-4.0 cm. long, 7-19 mm. wide, glabrous or occasionally with a few long trichomes above; peduncles slender, glabrous, up to 15 cm. long. Inflorescence a delicate, open, oblong-pyramidal panicle, terminal on the culm or leafy erect branches; branches few, spreading, the spikelets solitary at the tips of the branches. Spikelets laterally compressed, 6-8 mm. long, disarticulating below the glumes and at the base of the staminate floret; glumes 2-3 mm. long, the first broadly oblong, truncate, the apex truncate and ciliolate, 5-7-nerved; second glume narrower, oblong, blunt, 3-5-nerved; basal floret pistillate, the lemma 3.5-4.5 mm. long, narrowly



FIG. 222. *Zeugites mexicana*. A, blooming plant; B, spikelet, showing glumes, pistillate lowermost floret, and upper staminate florets.

oblong, blunt, erose, 9-11-nerved, palea slightly longer than the lemma, rachilla joint nearly as long as the lemma; staminate florets 1 or 2, occasionally the second reduced to a rudiment, disarticulating as a unit from the apex of the rachilla joint of the pistillate floret; lemmas 3.0-3.5 mm. long, ovate, acute, 3-5-nerved; anthers 3, 1.5-2.0 mm. long.

Rare; forests, brushy slopes, wet roadsides; 1,500-2,000 m. elevation. Costa Rican collections are known from Santa Maria de Dota, Cerro de Piedra Blanca above Escazú, and Los Cartagos. The small size of the plants and their tendency to grow under brush make them very inconspicuous, and they are probably often overlooked. They are recognizable at all seasons by their peculiar foliage, but blooming is sparse and restricted entirely to the short-day season of the year, from October to January. Southern Mexico to Colombia, Venezuela, and Bolivia.

***Zeugites pittieri* Hack., Oesterr. Bot. Z. 52:373. 1902. Figure 223.**

Caespitose perennial; culms in small clumps from hard knotty crowns, erect or arching, up to 4 m. long, branching above, the larger ones 0.5-1.0 cm. thick; internodes glabrous, smooth and shining, hollow; nodes glabrous, not prominent; prophylla brown, shining, 2 cm. long; leaf sheaths strongly ridged, 15-25 cm. long, truncate and prominently auriculate, minutely puberulent; leaf blades borne on flattened pseudopetioles 3-7 mm. long, which are densely hirsute above; blades flat, the larger ones 25-45 cm. long, 45-70 mm. wide, ovate, lower ones much reduced; blades provided with minute bicellular hairs having oblique cross-walls; uncinat microhairs present. Peduncle thick, stiff, 4-10 cm. long. Inflorescences borne at the apex of the culms and from upper leaf axils; inflorescence a somewhat congested panicle, 20-30 cm. long, ovoid; branches bearing spikelets nearly to their bases. Spikelets numerous, overlapping, lying parallel to the branches, laterally compressed, disarticulating below the glumes, 12-20 mm. long; first glume 4.5-5.5 mm. long, broadly obovate as folded, nerves 9-11, with cross-nerves; glumes ciliolate at tip and base; second glume 4-5 mm. long, 7-8-nerved, oblong as folded; lowermost floret pistillate, its lemma broadly ovate, saccate on the keel above the base, the lower portions firm and shining, callus pilose, tip ciliolate, nerves 7-13, tip acute or sometimes minutely awned from a bifid apex; lodicules 2, truncate, vasculated; pistil with 2 elongated naked styles bearing plumose stigmas; palea nearly as long as the lemma; staminate florets 6-14; lemmas 3.5-5.0 mm. long, ovate, acute or minutely awn-tipped, glabrous, nerves 7-8; stamens 3, the anthers 2.5 mm. long, yellow; lodicules 2, truncate, vasculated; palea nearly as long as the lemma. Chromosome number $n = 24$ from Costa Rican specimens.

Rare; brushy hillsides, 850-1,250 m. The type is *Pittier 1617* from Alto de Rodeo. The following recent specimens are also known: Heredia, Puente de Mulas, *P. & D. 11350, 11484*; San José, Guayabo de Mora, *P. & D. 11401*, San Gabriel, *P. & D. 11736*. Blooming plants were seen from late October to late February. This species does not occur elsewhere. Material reported to be of this species from Guatemala by Swallen (*Grasses of Guatemala*, 1955) is apparently *Z. latifolia* (Fourn.) Hemsl., a more northern species.

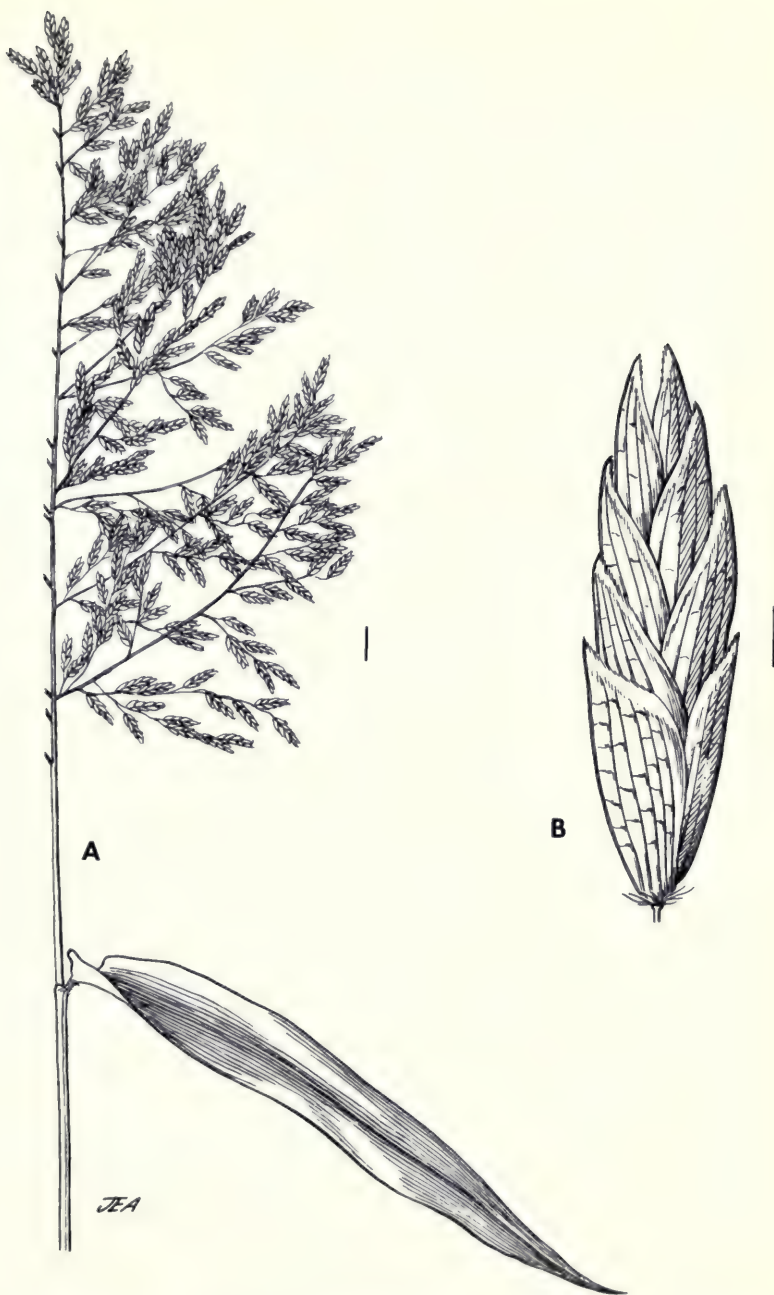


FIG. 223. *Zeugites pittieri*. A, panicle and pseudopetiolate leaf blade; B, spikelet.

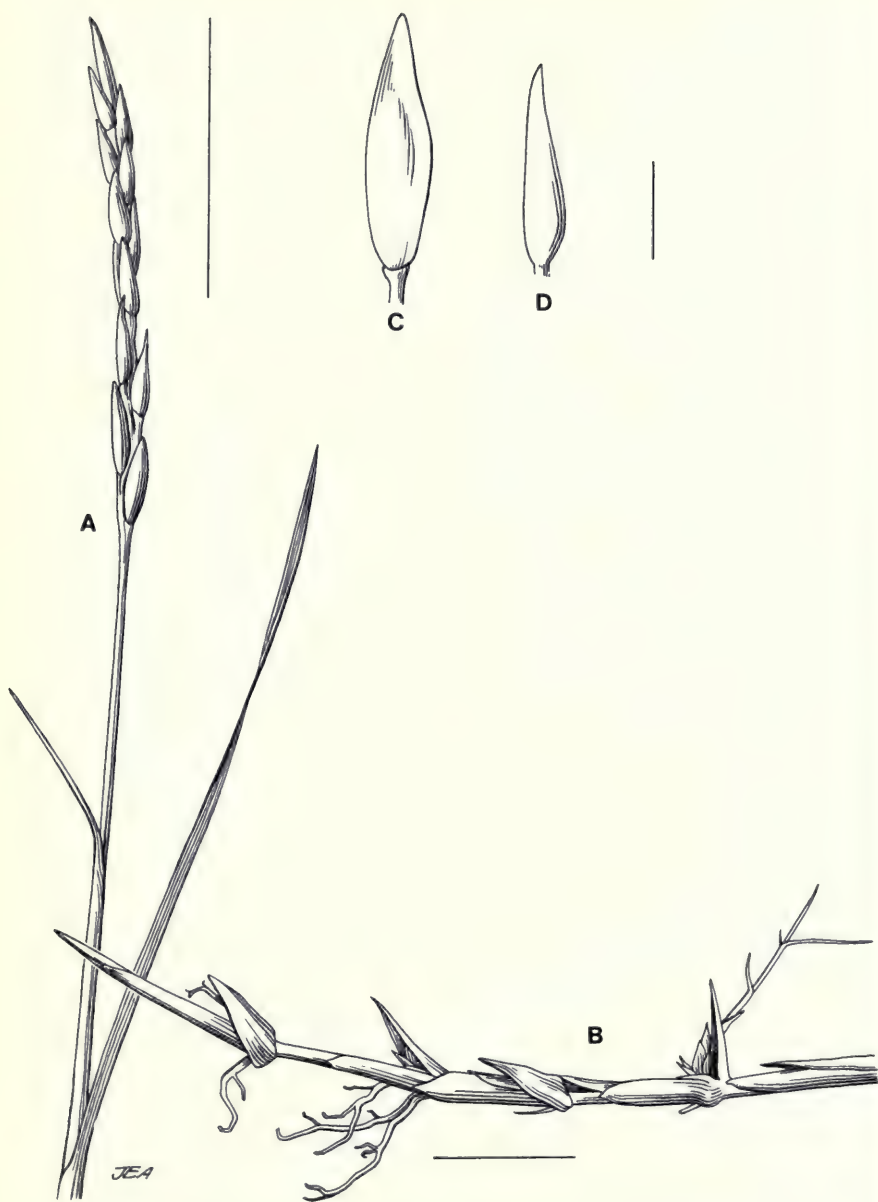


FIG. 224. *Zoysia tenuifolia*. A, raceme; B, rhizomatous base of plant; C, spikelet; D, floret.

ZOYSIA Willdenow
Nomen Conservandum

REFERENCES: Ian Forbes, Jr., Chromosome numbers and hybrids in *Zoysia*, *Agronomy J.* 44:194-99. 1952. W. D. Clayton & F. R. Richardson, The tribe Zoysieae Miq., *Stud. Gram.* XXXII, *Kew Bull.* 28:37-48. 1973.

Rhizomatous or stoloniferous perennials; inflorescence a solitary erect terminal raceme; pedicels solitary. Spikelets appressed to the rachis, laterally compressed, disarticulating entire; first glume absent; second glume stiff, acute or awn-tipped, the margins united below; floret one, concealed within the folded glume; lemma thin, 1-nerved, awnless; palea present or absent; stigmas and anthers exserted at the apex of the floret at anthesis; flower without functional lodicules, protogynous. (Chloridoideae: Zoysieae.)

Zoysia tenuifolia Willd. ex Trin., *Mém. Acad. Imp. Sci. St.-Petersbourg*, Sér. 6, Sci. Math. Seconde Pt. Sci. Nat. 2:96. 1838. Figure 224.

Stoloniferous perennial, often forming loose mounds if not mowed; foliage very fine-textured; sheaths and blades glabrous, the sheaths overlapping; ligule a minute ciliate fringe; leaf blades involute, 0.1-0.2 mm. thick, 2-3 cm. long. Peduncles included or exserted up to 1 cm.; raceme of 5-20 spikelets, these borne on erect pedicels and appressed to the rachis. Spikelets 2.5-2.8 mm. long, awnless; second glume stiff, lanceolate as folded; floret completely concealed within the glume; lemma narrowly lanceolate, 1-nerved. Chromosome number $n = 20$ (Forbes, 1952).

This species is rarely cultivated for lawns and may escape from cultivation. A large stand of it occurs around the weather station at the CATIE in Turrialba. It also occurs on the grounds of the experiment station at Guapiles, in Limón, and on the Campus of the University of Costa Rica, as well as in a park in Managua. Blooming has been observed in July, August, and December. South Pacific and eastern Asia; occasionally cultivated in subtropical and tropical regions.

The nomenclature of this genus is in confusion. Forbes believes that the taxa he studied cytologically and genetically constitute a single species, but the genus is in need of further study.

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New taxa and references to illustrations are in **boldface**. Common names and Latin names in synonymy are *italicized*.

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1	Cycadaceae	79	Monimiaceae	154	Cactaceae
2	Taxaceae	80	Lauraceae	155	Thymelaeaceae
3	Podocarpaceae	81	Hernandiaceae	156	Elaeagnaceae
4	Araucariaceae	82	Papaveraceae,	157	Lythraceae
5	Pinaceae		incl. Fumariaceae	158	Funariaceae
6	Cupressaceae	83	Capparidaceae	159	Lecythidaceae
7	Gnetaceae	84	Cruciferae	160	Rhizophoraceae
8	Typhaceae	85	Tovariaceae	161	Combretaceae
9	Potamogetonaceae	86	Rosaceae	162	Myrtaceae
10	Najadaceae	87	Moringaceae	163	Melastomataceae
11	Alismataceae	88	Droseraceae	164	Onagraceae
12	Butomaceae	89	Grassiliaceae	165	Halorrhagaceae
13	Hydrocharitaceae	90	Saxifragaceae	166	Araliaceae
14	Triuridaceae	91	Bruniaceae	167	Umbelliferae
15	Gramineae	92	Cunoniaceae	168	Cornaceae
16	Cyperaceae	93	Hamamelidaceae	169	Clethraceae
17	Palmae	94	Rosaceae	170	Monotropaceae
18	Cyclanthaceae	95	Conaraceae	171	Pyrolaceae
19	Araceae	96	Leguminosae	172	Ericaceae
20	Lemnaceae	97	Krameriaceae	173	Theophrastaceae
21	Mayacaceae	98	Oxalidaceae	174	Myrsinaceae
22	Xyridaceae	99	Geraniaceae	175	Primulaceae
23	Eriocaulaceae	100	Tropaeolaceae	176	Plumbaginaceae
24	Bromeliaceae	101	Linaceae,	177	Sapotaceae
25	Commelinaceae		incl. Humiriaceae	178	Ebenaceae
26	Pontederiaceae	102	Erythroxylaceae	179	Symplocaceae
27	Juncaceae	103	Zygophyllaceae	180	Styracaceae
28	Liliaceae	104	Rutaceae	181	Oleaceae
29	Haemodioraceae	105	Simarubaceae	182	Loganiaceae
30	Amaryllidaceae	106	Burseraceae	183	Gentianaceae
31	Velloziaceae	107	Meliaceae	184	Apocynaceae
32	Dioscoreaceae	108	Malpighiaceae	185	Asteraceae
33	Iridaceae	109	Trigonaceae	186	Convolvulaceae
34	Musaceae	110	Vochysiaceae	187	Polemoniaceae
35	Zingiberaceae	111	Polygalaceae	188	Hydrophyllaceae
36	Cannaceae	112	Dichapetalaceae	189	Boraginaceae
37	Marantaceae	113	Euphorbiaceae	190	Verbenaceae
38	Burmanniaceae	114	Callitrichaceae	191	Labiatae
39	Orchidaceae	115	Buxaceae	192	Solanaceae
40	Casuarinaceae	116	Coriariaceae	193	Scrophulariaceae
41	Piperaceae	117	Anacardiaceae	194	Bignoniaceae
42	Chloranthaceae	118	Cyrillaceae	195	Pedaliaceae
43	Lacistimaceae	119	Aquifoliaceae	196	Martyniaceae
44	Salicaceae	120	Celastraceae	197	Orobanchaceae
45	Garryaceae	121	Hippocrateaceae	198	Gesneriaceae
46	Myricaceae	122	Staphyleaceae	199	Lentibulariaceae
47	Juglandaceae	123	Icacinaceae	200	Acanthaceae
48	Batiaceae	124	Hippocastanaceae	201	Plantaginaceae
49	Betulaceae	125	Sapindaceae	202	Rubiaceae
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60	Rafflesiaceae	136	Actinidiaceae		
61	Balanophoraceae	137	Ochnaceae		
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63	Chenopodiaceae	139	Marcgraviaceae		
64	Amaranthaceae	140	Quinaceae		
65	Nyctaginaceae	141	Theaceae		
66	Phytolaccaceae	142	Guttiferae		
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69	Basellaceae	144	Cistaceae		
70	Caryophyllaceae	145	Rixaceae		
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72	Ceratophyllaceae	147	Violaceae		
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77	Anonaceae	152	Loasaceae		
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